AFIT/GLM/LSM/92S-41

A STUDY OF CONFIGURATION MANAGEMENT AT HEADQUARTERS LOGISTICS COMMAND (ROYAL AUSTRALIAN AIR FORCE)

THESIS

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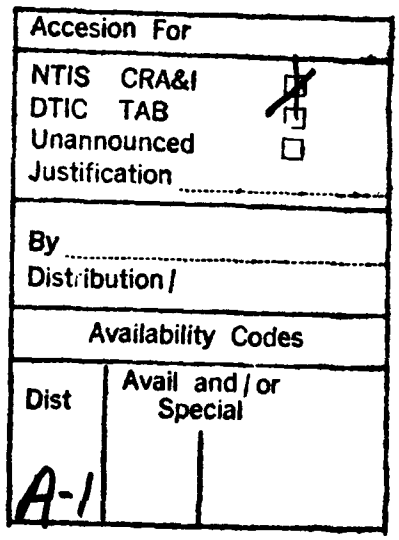

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THESIS

Presented to the Faculty of the School of Systems and Logistics of the Air Force Institute of Technology
Air University
In Partial Fulfillment of the
Requirements for the Degree of
Master of Science in Logistics Management

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September 1992

Acknowledgements

The purpose of this study was to provide insight into configuration management procedures conducted by the Engineering Logistics Branch of Headquarters Logistics Command, Royal Australian Air Force. I have been influenced by several people while conducting this research, and would like to take this opportunity to thank them all.

In particular, I would like to thank my thesis advisors: Major Dennis Hull, Professor William Dean, and Captain Brian Holmgren, for their patience as they endured the continuous changes in direction while I refined the topic area, and for their advice and expertise in shaping the final report. I would also like to thank my lecturers, particularly Major Jake Simons and Professor Daniel Reynolds for their teaching expertise and passion for their subjects, and also to Lieutenant Colonel Richard Moore for his part in awakening me to a new management philosophy.

I give special thanks to my brother, Warrant Officer Garry Turner, who had the thankless task of being my liaison officer in HQLC and volunteered responsibility for the production, distribution, and collection of the research surveys, in addition to helping me to gain access to reference literature. My thanks also go to Flight Sergeant Paul Collins for his part in helping me to gain access to

reference material from the Directorate of Telecommunications Engineering - Logistics Command.

Finally, and most importantly, I am deeply grateful to my family. As a veteran student's wife, Wendy, has remained forever supportive and understanding, despite the many pressures I have placed upon her. I apologize to my children: Casey, Ben, Natalie, and Andrew, and promise to make it up to them.

John F. Turner

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Abstract

The purpose of this research was to provide insight into configuration management at the Royal Australian Air Force's Headquarters Logistics Command (HQLC) by determining whether current configuration management practices have any impact on HQLC's ability to meet its mission of providing engineering logistics support. The research begins with a review of RAAF configuration management policy and procedures as applicable to in-service systems or technical equipment.

A case study is used to investigate problems associated with inadequate configuration management being experienced by one HQLC engineering section, and to identify subsequent effects on engineering logistics support capability. The case study results are used to design measurement questions on a survey instrument which is used to gather data on HQLC Logistics Engineering (LOGENG) Branch as a whole.

The research indicated that configuration management has not been fully adopted by HQLC LOGENG. Additionally, HQLC LOGENG sections are experiencing the same problems and associated effects on engineering logistics support capability as was found in the case study.

Recommendations include: establishing training courses over the short and medium terms, establishing a configuration management Centre of Excellence, and creating

a HQLC project team to fully investigate the introduction of configuration management as a fundamental management tool.

A STUDY OF CONFIGURATION MANAGEMENT AT HEADQUARTERS LOGISTICS COMMAND (ROYAL AUSTRALIAN AIR FORCE)

I. Introduction

Overview

This chapter introduces problems being experienced by Royal Australian Air Force (RAAF) engineering management personnel in managing the configuration of in-service technical equipment. A problem statement will be developed and expressed in terms of a research question. Specific investigative questions will also be listed.

Definitions and assumptions are presented and the research scope and limitations are given. The chapter concludes with an explanation of benefits arising from the research effort and a thesis overview.

Background

As commander of Headquarters Logistics Command (HQLC), Air Officer Commanding Logistics Command (AOCLC) has been delegated responsibility for certain engineering functions for in-service aircraft and other technical equipment (45:1; 40:1). As illustrated in Figure 1, a Logistics Engineering (LOGENG) Branch has been established within HQLC under the executive management of the Director General of Engineering and Logistics, Standards and Systems (DGELS-LC) (40:1).

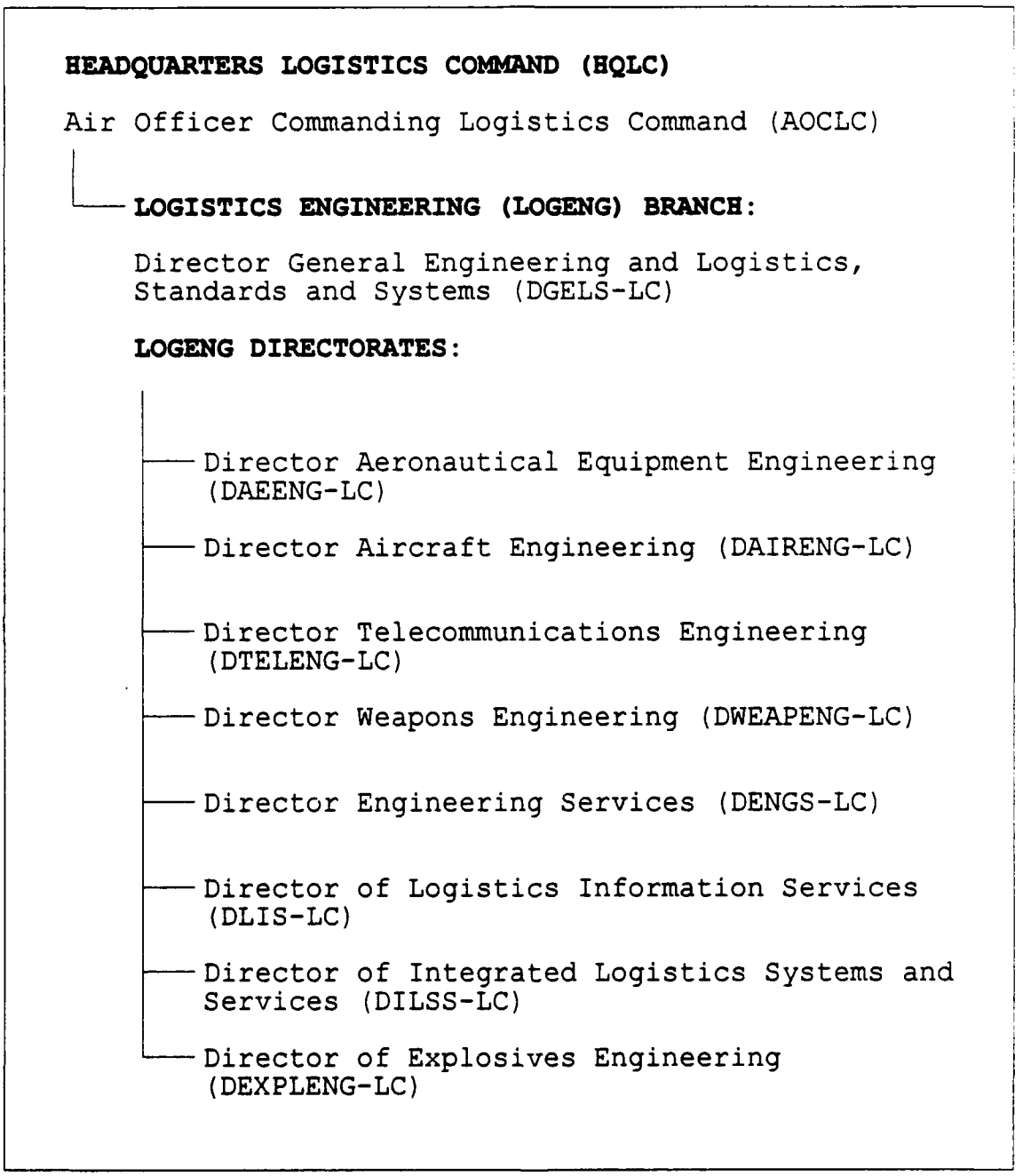


Figure 1: Partial Organization Diagram for HQLC Showing the Logistics Engineering Branch. (Adapted from 47:25; 46:1-2; 40:1-2)

AOCLC has delegated his engineering responsibilities to DGELS-LC. Figure 1 shows that LOGENG Branch is divided into Directorates, each commanded by a Director. DGELS-LC has delegated engineering responsibility for specific categories of technical equipment and/or responsibility for specific engineering services to the various Directors (40:1). Engineering functions are many and varied (45; 40), but include managing the configuration of RAAF technical equipment throughout its life-of-type (45:1). Configuration management is "that area of management concerned with the systems and procedures for controlling performance requirements and physical configuration of designated items" (27:1; 32:para 2401).

Configuration management procedures for a given item of technical equipment are described in a Configuration Management Plan (Air Force) [CMP(AF)] (33:1). The importance of configuration management activities is reflected in the following statement:

> Failure to initiate or implement a CMP(AF) can have adverse effects on the ability of the engineering and maintenance elements of the RAAF to maintain technical equipment so that it continues to meet the operational requirement. (33:1)

Configuration management activities are therefore useful in ensuring HQLC successfully performs its strategic responsibilities, which includes provision of logistics support to the RAAF (47:20). However, several engineering elements within HQLC report they are unable to provide

satisfactory logistics support for technical equipment due to inadequate system configuration management (2:88-89; 3; 19; 21; 24). For example, the configuration status of in-service equipment may be unknown and the associated technical documentation either incomplete, or inaccurate. As a consequence, delays are experienced in performing engineering tasks (such as defect investigations, evaluation of modification proposals, design of changes to configuration, and responding to user requests for assistance) while the exact configuration of the affected item is determined. Implementation of modification programs for urgently needed operational requirements might be delayed while designs are verified or reworked. Moreover, field technicians might be using inaccurate technical documentation to perform maintenance activities on operational equipment.

Problem Statement

The mission of HQLC is "to provide and sustain quality logistics support for RAAF and assigned [Australian Defence Force (ADF)] operations" (42). Configuration management contributes to the HQLC mission by providing procedures which help engineering managers ensure technical equipment continues to meet the operational requirement. But, as described above, some sections within LOGENG Branch are known to be concerned over their ability to provide required

engineering logistics support because of inadequate configuration management.

Since a few sections within HQLC LOGENG are known to be experiencing problems with inadequate configuration management, it may be reasonable to assume other sections might also be experiencing similar problems. The problem might even permeate throughout the entire HQLC logistics engineering organization to the extent that HQLC's ability to provide engineering support is adversely affected. Consequently, HQLC might be ineffective in satisfying its mission. However, no study has yet been undertaken to determine if current configuration management practices within HQLC LOGENG Branch have any impact on engineering logistics support.

Research Objective

The objective of this research was to provide insight into configuration management at HQLC by answering the following research question:

> Research Question. Do current configuration management practices within HQLC LOGENG Branch have any impact on HQLC's ability to provide engineering logistic support to the RAAF?

Investigative Questions

The research question was answered using the following hierarchy of investigative questions:

> Investigative Question 1. Are configuration management procedures being used?

Investigative Question 2. Is inadequate configuration management being experienced?

Investigative Question 3. Is there any impact on engineering logistics support capability?

Definitions

A list of abbreviations and acronyms is included at Annex A. A list of definitions is included at Annex B.

Assumptions

Although the RAAF is continually undergoing changes, the research was conducted over a particularly volatile period. Some of the changes will have a direct impact on the way HQLC will execute its responsibilities for the foreseeable future. These include:

a. the introduction of Weapons System Logistics Management (WSLM);

b. the introduction of a system of awarding licenses to engineers to indicate they are certified to authorize changes to configuration (licenses would only be issued to those engineers meeting strict guidelines);

c. an initiative introduced by DGELS-LC requiring configuration management plans be raised for all HQLC managed systems and technical equipment; and

d. a review of configuration management policy and procedures which will eventually see existing policy and procedures replaced.

These changes were assumed not to have influenced HQLC LOGENG personnel.

Scope

The research considered the impact of configuration management procedures from the perspective of HQLC LOGENG Branch. Accordingly, the research concentrated on systems and technical equipment in the operational phase of the life cycle. However, a study of configuration management is incomplete without some discussion of the concept, development, and production phases of the life cycle.

Limitations

The research was limited by physical distance between the researcher and the centre of study. Accordingly, access to source material and LOGENG technical and engineering staff was limited. Consequently, the quality of the literature review may have been affected.

As discussed, the RAAF has undergone dramatic changes during the research period. The researcher was not entirely familiar with the details of these changes and therefore could not predict their possible impact. Although the changes were assumed not to have any impact, this assumption proved not to be entirely valid since some of the survey respondents made reference to draft policy and procedures.

HQLC LOGENG personnel are not the only personnel having an interest or responsibilities in configuration management. For example, HQLC personnel responsible for spares

provisioning are interested in configuration management issues. Similarly, HQLC engineering logistics management for the F/RF-111C has been devolved to a trial WSLM centre establish at RAAF Base Amberley in Queensland. Personnel assigned to this WSLM also have a configuration management interest and responsibility. The research only considered HQLC LOGENG Branch, and did not cover other areas (such as spares provisioning or F/RF-111-C logistics) having interest in configuration management issues.

Finally, the study does not specifically address software configuration management issues.

Benefits of the Research

Knowledge gained by this research can be use to guide management decisions on the implementation of configuration management procedures within HQLC LOGENG Branch. The research indicates where management efforts might best be concentrated to extract the benefits of configuration management.

Additionally, the research results can be used as the basis of a cross-sectional study to assess the impact of new policy and procedures which are soon to be issued.

Thesis Organization

The remainder of the thesis presents an overview of RAAF configuration management and documents the research methodology, findings and analysis. Chapter II describes configuration management and includes an overview of RAAF

configuration management policy and procedures. Chapter II also includes case study and other material used to describe the problem that led to the research objective. Chapter III presents the research methodology and includes a discussion of how the research objective was met. Research findings are presented in Chapter IV and conclusions and recommendations are offered in Chapter V.

II. Literature Review

Overview

This chapter begins with a brief description of configuration management and continues with the framework of RAAF configuration management policy and procedures applicable to in-service systems and technical equipment. The chapter presents an outline of implementation of configuration management within the RAAF and discusses the major configuration management components. The objectives of configuration management and the associated benefits are summarized. The chapter includes a discussion of case study and other material used as the basis for identifying problems presented in Chapter I and concludes by describing the relevance of the material to the research objective.

Introduction to Configuration Management

The term "configuration management" implies some type of activity associated with "managing the configuration" of something, where configuration is defined as "the relative disposition of the parts or elements of a thing" (7:193). From this definition, one can readily understand why configuration management might be thought to be concerned only with the way in which parts of a system or technical equipment are joined together. Fighter aircraft might be 'configured' to carry either missiles or external fuel tanks, or some combination of the two. Production personnel

might be concerned with the way parts fit together to facilitate assembly on a production line.

Yet configuration management involves more than these examples illustrate. RAAF managers of capital acquisition projects might be interested to know if the equipment being developed will satisfy the intended operational requirement. Logistics spares provisioners might be concerned with the details of a particular part so they may engage in resupply activities. Systems engineers might be concerned with the specifications or physical layout of a system or technical equipment so they might investigate system defects or design system modifications. Configuration management is one way in which all of these activities can be simultaneously supported.

In broad terms, configuration management is an "area of management concerned with systems and procedures for controlling both performance requirements and physical configuration of systems or technical equipment" (32: para 2401). Thus, configuration management is one way of ensuring systems and technical equipment are developed to conform to functional requirements as defined in the original needs documentation. Additionally, configuration management also ensures the configuration of systems and technical equipment is known and controlled throughout the life cycle. Such knowledge of the configuration, and control over changes to configuration, is required

throughout the life cycle in order to facilitate safety, operational capability, and logistics support (31:1).

From a HQLC LOGENG Branch perspective, engineering managers can use configuration management as a tool to help them record, control, and communicate design integrity, design traceability, and engineering and cost trade-off decisions made among technical performance, producibility, operability, and supportability (31:1). Thus configuration management provides a history of operational, engineering, and logistics management decisions throughout the life cycle of the system or technical equipment.

Configuration management is defined in the RAAF as "the discipline of applying technical and administrative direction and surveillance to:

a. identify and document the functional and physical characteristics of a configuration item,
b. control changes to those characteristics, and
c. record and report change processing and implementation status." (31:1)

This definition identifies three basic processes associated with configuration management, namely configuration identification, configuration control, and configuration status accounting. Configuration audits are also required to ensure that, in general, configuration management processes are being carried out correctly, and specifically, the configuration of a system or technical equipment remains in concert with its identification. (28:1)

Introduction to RAAF Configuration Management Policy and Procedures

RAAF configuration control activities have historically been based upon systems and procedures outlined in the UK Ministry of Defence publication AV P 25 (32:Foreword). The US military has also practiced principles and procedures used to control the design, development, production, and maintenance of systems and equipment. These principles and procedures have been standardized, under the label of configuration management, to facilitate communication between various organizations (28:1). The US Department of Defense (DoD) has promulgated configuration management policy and procedures in a series of directives, instructions, regulations, pamphlets and military standards (for example: 13; 14; 12; 15; 9; 8). Similarly, RAAF configuration management policy and procedures are promulgated in various instructions and publications, and a review of these documents suggests contemporary RAAF configuration management policy and procedures are based predominantly upon the US DoD system.

Figure 2 illustrates the hierarchy of RAAF configuration management policy documents. The joint ADF policy for configuration management of systems and equipment is stated in Defence Instruction (General) Administration 36-1 [DI(G) ADMIN 36-1] (issued as Defence Instruction (Air Force) Operations 2-7 [DI(AF) OPS 2-7]) (31). Joint ADF configuration management policy is translated into RAAF

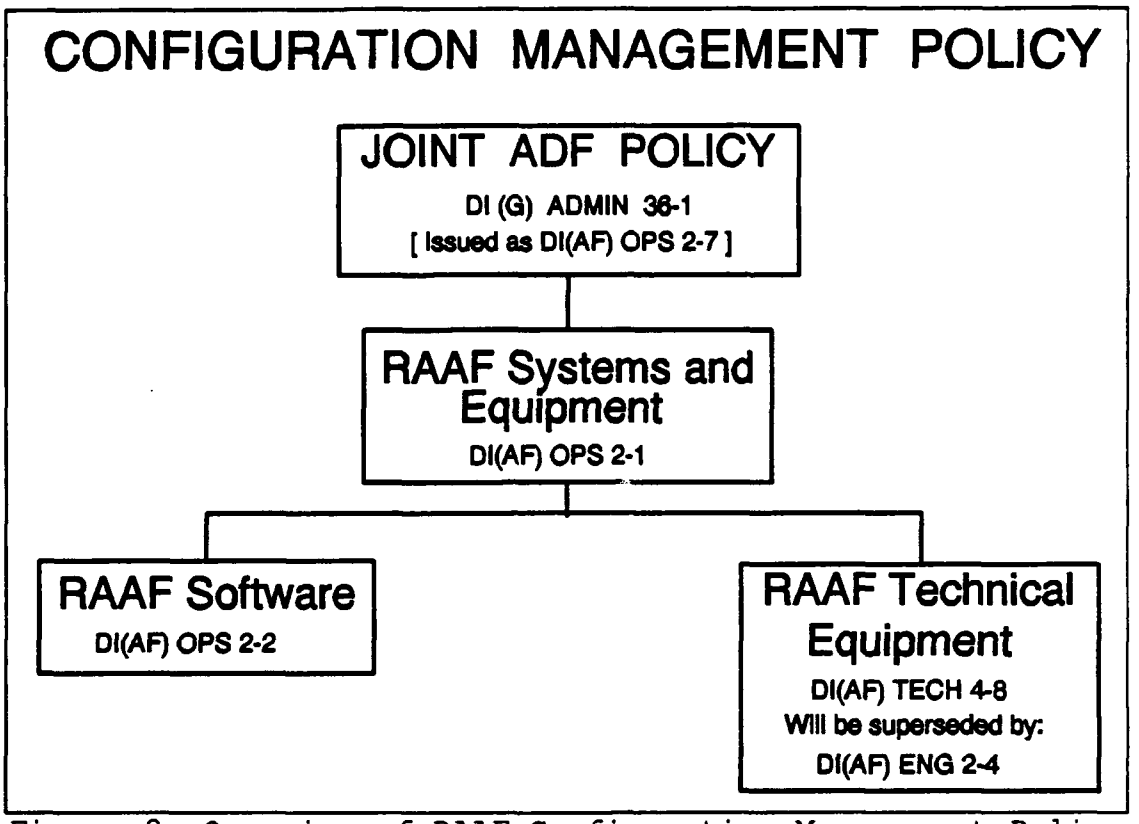


Figure 2: Overview of RAAF Configuration Management Policy

policy for systems and equipment, which is stated in DI(AF) OPS 2-1 (28). Guidance for configuration management of RAAF software is provided in DI(AF) OPS 2-2 (30), while further policy direction for configuration management of RAAF technical equipment is expressed in Defence Instruction (Air Force) Technical 4-8 [DI(AF) TECH 4-8] (33), which should be read in conjunction with DI(AF) OPS 2-1.

Figure 3 illustrates a simplified view of the hierarchy of configuration management procedural documents. Configuration management procedures for the design, development, production, and modification of RAAF technical equipment are contained in Defence Instruction (Air Force)

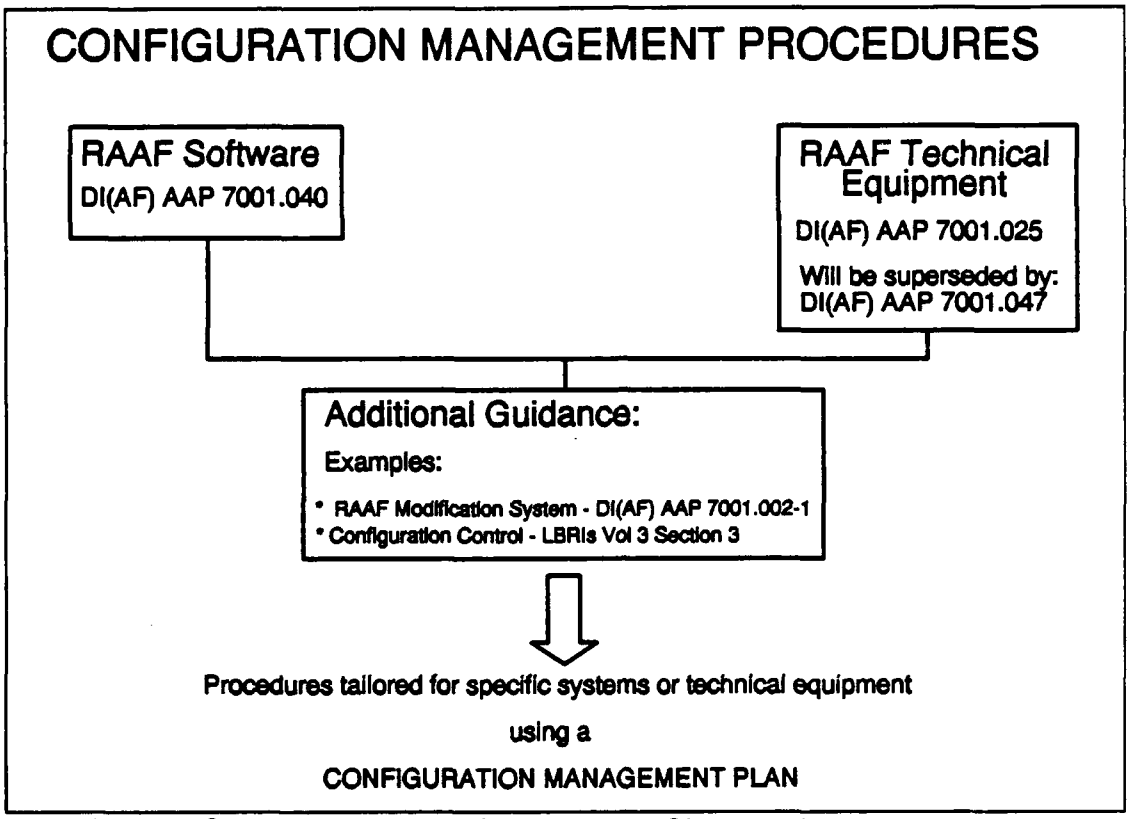


Figure 3: Overview of RAAF Configuration Management Procedures

Australian Air Publication 7001.025 [DI(AF) AAP 7001.025] (32). Additional procedures for software configuration management are contained in DI(AF) AAP 7001.040 (41).

HQLC has a long term plan to produce a RAAF Manual of Logistics which will "cover all aspects of the RAAF Logistics System" (36). As an interim measure, Logistics Branch Routine Instructions (LBRIs) have been prepared in a six-volume set to "advise [HQLC] Logistics staff in the day-to-day processing of logistics requirements" (36). Logistics requirements include, among other things, aspects

of configuration management such as configuration control (26) and modifications (39).

Other instructions and publications address specific configuration management issues. For example, general policy and procedures for modification of RAAF technical equipment is stated in DI(AF) TECH 19-1 (38), and a description of the RAAF Modification System is published in DI(AF) AAP 7001.002-1 (43).

While the policy and procedural documents described hitherto refer to RAAF configuration management in general, configuration management procedures tailored for specific systems or items of technical equipment are contained in a dedicated Configuration Management Plan - Air Force (CMP-AF) (28:1-2; 32:Chapter 24; 33:1-2).

RAAF configuration management policy and procedures have been the subject of a recent review. As a consequence, RAAF configuration management policy for systems and equipment, used since 1981 (27), has been reissued (28). Also, the DI(AF) TECH series of instructions are being revised and replaced by a new DI(AF) Engineering [DI(AF) ENG] series. As part of this rewrite, configuration management policy for RAAF technical equipment stated in DI(AF) TECH 4-8 will be rewritten and issued as DI(AF) ENG 2-4. Finally, configuration management technical procedures given in DI(AF) AAP 7001.025 (32) will be rewritten and issued as DI(AF) AAP 7001.047. DI(AF) ENG 2-4 and DI(AF)

AAP 7001.047 are currently available only in draft form (34 and 29, respectively).

Configuration Management in the RAAF

Configuration management is not automatically applied to all systems or technical equipment. Instead, the configuration management process is "tailored to the quantity, size, scope, life, nature, use and complexity of the system or [technical] equipment" (28:1; 31:1). The tailoring process is achieved in part by the appropriate selection of items, called configuration items, which are to be configuration managed. Since configuration management is to be applied to all configuration items in the RAAF (28:2), selection of configuration items becomes an important part of the configuration management process.

Despite its importance, very little guidance is currently given to help RAAF personnel select configuration items. Joint ADF configuration management policy suggests that selection of configuration items is "determined by the need to control inherent characteristics and interfaces with other systems or equipment and is based on analysis of operational, engineering and logistical factors" (31:2). This guidance might not be helpful in practice. The need to select configuration items may be partially offset by RAAF configuration procedures which mandate the "management and control of the configuration of all major items of technical equipment" (32:Chapter 24), where, in this case, a major

item of technical equipment is one that is subject to RAAF capital equipment procedures (25:Chapter 1). However, HQLC personnel are not normally directly associated with major items of technical equipment until they are transitioned to the operational phase of its life cycle. RAAF configuration management procedures also provide for application of configuration management to any item of technical equipment as is deemed necessary, but it does not discuss circumstances where this might be appropriate (32:Chapter 24). This may further diminish the need to select configuration items.

The level of assembly at which configuration items are identified also depends upon the stage of development of the system or technical equipment and on the resources available (31:1). Once an item has been selected as a configuration item, it comes under the full control of RAAF configuration management procedures. In the early phases of the life cycle, configuration items will normally be restricted to those top level items which require preparation of a functional specification, with further selections of configuration items being made as the life cycle advances (28:1). Selection of large numbers of lower level configuration items should be delayed as long as possible in the production process to avoid both the inhibiting of design activities and the need to maintain and coordinate paperwork necessary for effective control of changes to the configuration. For those systems or technical equipments in

the operational phase of the life cycle, configuration items might include items at the repairable level (28:2). Whatever the criteria used, an item can be designated as a configuration item only by the Head of the Division assigned responsibility for its management (31:3).

The draft RAAF configuration management procedures, to be issued as DI(AF) AAP 7001.047, will include a comprehensive guide to the selection of configuration items, including the following:

a. Criticality. An item should be identified as a configuration item if its failure would adversely affect security, human safety, accomplishment of a mission, or would have significant financial impact.

b. Change Activity. Items which are expected to have a significant number of changes to them throughout their life cycle should be identified as configuration items. (29:Chapter 3, Annex B)

Additionally, the draft RAAF configuration management procedures extend the definition of a configuration item to include any repairable item that is designated for separate procurement during the operation and maintenance period of the life cycle (29:Chapter 1, Annex A). This approach is more consistent with the US DoD procedures which state that "any item requiring logistics support or designated for separate procurement is a [configuration item]" (11:6; 12:26). However, this approach needs to be carefully

balanced by considering the level of resources available to support configuration management. Further, care must be taken to avoid the adverse affects of having too many configuration items (29:Chapter 3, Annex B; 10:117).

Configuration management procedures need not be fully applied to a given configuration item. The degree to which configuration management procedures are applied to a given configuration item is determined by the Head of the Division responsible for its management (31:3; 28:2). Moreover, each configuration item is to have a documented configuration management system (31:3). In the RAAF, the configuration management procedures applicable to a configuration item, and the extent to which those procedures apply, are described in a Configuration Management Plan (Air Force) [CMP(AF)] (31:3; 28:2; 33:1). The CMP(AF) addresses configuration identification, configuration control, configuration status accounting, and configuration audits for the system or technical equipment life cycle (31:3; 28:1).

Configuration Identification

Configuration identification is defined in the RAAF as:

> the current approved [...] technical documentation for a configuration item as set forth in specifications, drawings and associated lists and documents referenced therein. (31:A-1)

Thus configuration identification is a term used to describe the formal technical definition of a system and its parts (32:Chapter 24).

Use of the term "current" in the above definition implies that the documentation is not static. Indeed, the technical documentation changes in concert with changes to the configuration of the system or technical equipment as it evolves throughout its life cycle - from concept through design, development, production and operational service.

The success of effective configuration management depends upon an accurate and current configuration identification. This concept is the basis for using configuration baselines which formally establish the configuration identification of a system or technical equipment at specific predetermined points during the design, development and production phases. (33:1)

Using the notion of a baseline, configuration identification of a system or technical equipment is comprised of the currently approve baseline, plus documentation describing any changes from that baseline (28:1).

The draft RAAF configuration management procedures identify three configuration management baselines, namely the functional, allocated, and product baselines (29:Chapter 1, Annex A). Since each baseline has a corresponding configuration identification comprised of the baseline plus any approved changes, there are three configuration identifications, namely the functional configuration identification, allocated configuration identification, and product configuration identification. Each baseline and

associated configuration identification is established at a particular phase in the life cycle, as follows:

a. The functional baseline and associated functional configuration identification are established during the concept exploration and definition phase.

b. The allocated baseline and associated allocated configuration identification are established during the demonstration and validation phase.

c. The product baseline and associated product configuration identification are established during the full-scale development/low rate initial production phase. (29:Chapter 3, Annex A)

The level of detail under RAAF control increases progressively as each baseline is established. Since the product baseline is normally the last baseline to be established before the system or technical equipment is released for operational use, the product configuration identification is the one used by HQLC personnel as the basis for describing the functional and physical characteristics of systems and items of technical equipment under their management control.

RAAF configuration management procedures for technical equipment (32) refer to "Design Certificates" and "Type Records" as part of the requirements of configuration management. A Design Certificate is the document, issued and signed by the Design Authority, which certifies that,

except where listed, an equipment design complies with the specification (32:Chapter 2). The Design Authority is the contractor who is responsible for the design of the item and who is empowered to sign the Design Certificate (32:Glossary). Submission of the Design Certificate initiates RAAF action to conduct tests and trials, with limited contractor involvement, to verify design and performance (32:Chapter 2). Following completion of RAAF trials and test, the contractor is required to assemble and submit the type record for approval. The type record is described by the following:

> Type Record. A type record is a document giving a definitive description of the item, design assumptions, strength calculations including reference to material data sheets, strength factors, aerodynamic and static loads, environmental conditions, qualification tests and results, a list of approved manufacturing drawings, procedure and process sheets (Master record Index Number), weight data, design performance and handling limitations and a list of subsidiary type records or equivalent approvals in respect of equipments manufactured by sub-contractors. The Design Certificate is attached to, and forms [a] part of the type record. In some cases, the Design Certificate, with relevant supporting data, is acceptable as a type record. (32:Glossary)

The description of a type record suggests that it is similar to a configuration identification. In fact, a type record constitutes the product baseline of the item. Thus, the type record, plus any approved changes, forms the product configuration identification for the item on delivery to the RAAF for operational use and at any later point in its operational life. (32:Chapter 2)

RAAF approval of the type record constitutes type and design approval for the technical equipment and provides "evidence that its design and development has been completed to the requirements of the RAAF" (32:Glossary). All new technical equipment designed and produced for the RAAF must be given type and design approval before it is offered for acceptance prior to delivery (32:Chapter 2).

Having produced a technical description of the system or technical equipment, the next requirement of configuration management is to control any changes made that affects the performance capabilities and/or the design of the system or technical equipment.

Configuration Control

Certain configuration control functions are essential to successful implementation of configuration management (33:2). These functions include control of the following:

a. design (such as responsibility for design or approval of design);

b. data (such as specifications, drawings or manuals);

c. maintenance (such as maintenance procedures or trade standards); and

d. changes to baseline (such as modifications). (33:2)

Configuration control is defined in the RAAF as:

> the systematic evaluation, coordination, approval or disapproval of changes, and implementation of

all approved changes in the configuration of an item after the initial definition of configuration. (31:A-1)

From this definition, configuration control activities begin only after the initial configuration baseline has been established. Thus, configuration control commences in concert with the formal establishment of the functional baseline, which occurs during the concept exploration and definition phase of the life cycle.

The RAAF implements configuration control of technical equipment predominantly through the RAAF Modification System (38; 32:Chapter 19; 43; 37; 26; 39). A modification is "an approved design change to RAAF technical equipment which:

a. affects the safety, operational use, reliability or other specific design requirement of the equipment;

b. involves significant changes in production or changes which have to be made to equipment already produced or supplied;

c. affects the cost or delivery programme of the equipment or its Service spares; or,

d. affects interchangeability of the equipment or of its Service spares." (32:Chapter 19; 43:1; 37:1)

The definition of configuration control suggests four main elements as follows:

a. evaluation,

b. coordination,

c. approval, and

c. implementation.

Evaluation. Proposals for modifications to technical equipment must be evaluated to ensure the need for the

modification actually exists (39:Chapter 2). In general, modification proposals originate from either within the RAAF or from agencies outside the RAAF, such as other Services, other operators of the equipment, manufacturers and repair contractors. Proposals from within the RAAF are submitted as Draft Modification Orders (DMOs), while proposals from agencies outside the RAAF are normally submitted in the form of an Engineering Change Proposal (ECP) (32:Chapter 19). Draft RAAF configuration procedures will require all modification proposals to be submitted in the form of ECPs (29:Chapter 4). The RAAF definition of configuration control does not directly identify the proposal as a specific element. This is in contrast to the US DoD definition which has defined configuration control to include the proposal as an element (12:33).

ECPs and DMOs must be evaluated on many aspects, including the following:

a. Operational. From an operational perspective, modifications may be required to upgrade the performance or capability of technical equipment. Alternatively, modifications may be required to overcome deficiencies in existing performance or capabilities. (39:Chapter 2)

b. Engineering and Maintenance. From an engineering perspective, modifications are proposed in response to concerns over: safety, reliability, maintainability, or some other related aspect.

The proposal must be evaluated to identify potential benefits and impact, if any, on support or operational requirements. For example, modifications should not affect the performance and capabilities implemented to meet operational requirements. Any modification proposal affecting the operational environment must be first endorsed by the appropriate Operational Staff at the Department of Defence - Air Force (DEFAIR) (32:Chapter 19).

Additional engineering and maintenance evaluation considerations given in LBRIs include: ensuring the modification is applicable to RAAF equipment or aircraft, ensuring the proposed design is adequate and does not need to be redesigned, and ensuring design integrity factors (such as reliability and maintainability, failure modes and effects, and safety) are adequately considered (39:Chapter 2).

c. Supply. Modifications proposed for supply reasons, such as replacing items that are no longer in production or otherwise become unsupportable, need to be evaluated to ensure replacement items meet the operational needs at minimum cost. In particular, replacement items should not provide for increased performance or

capability if the operational requirements remain unchanged. (32:Chapter 19)

d. Economic Factors. Although a proposed modification might be technically justified, it should not be implemented unless it is cost-effective. For example, a modification should not normally be implemented unless they will be succeeded by at least two years of installed benefit. (32:Chapter 19; 39:Chapter 2)

Coordination. Coordination involves arranging for liaison, as necessary, between the affected agencies responsible for various aspects of modification management. Effective coordination ensures all requirements of the modification are accomplished in a timely and effective way and without duplication of effort or resources. A Local Modification Committee (LMC) is one approach used to coordinate efforts by assembling affected personnel to discuss aspects of the proposed modification. In addition, System Engineers are to liaise with any and all affected agencies (whether or not they are members of the LMC) to ensure successful implementation. (39:Chapter 5)

Approval. Except where special provisions apply (such as in times of war), the only modifications that can be made to aircraft or technical equipment are those authorized by HQLC (38:2). Approval of accepted modification proposals requires approval of both technical and financial aspects. Form SP227, Authorization of a Modification to Technical

Equipment is used to obtain financial and technical approval for accepted modification proposals and is the document that authorizes a change to the currently approved configuration of technical equipment (32:Chapter 19). The completed SP227 initiates a series of actions which culminate with a completed Modification Order which is released to end users in the form of an amendment to the relevant Australian Air Publication (AAP).

Implementation. Form SP227 provides financial and technical approval to change the configuration of technical equipment, but it does not provide authority for the modification to be implemented. HQLC issues Modification Orders which are used by RAAF and contractor personnel as authority to implement configuration changes. Modifications are to be incorporated in accordance with the procedures and time scale given in the Modification Order. Modification Orders are assigned one of six classes, depending on the circumstances and urgency of their implementation. Additionally, configuration changes that are especially urgent can be implemented under the authority of a Special Technical Instruction (STI) issued from HQLC (44). However, when an STI is issued, it must be subsequently followed with a formal Modification Order. Personnel are required to advise HQLC, in accordance with instructions on the Modification Order, when a modification has been implemented. (32:Chapter 19; 38)

Configuration Status Accounting

The two elements of configuration management presented hitherto essentially involve the identification of those items requiring configuration management and the control of any changes made to their configuration. The collection and reporting of information necessary for these activities to be conducted effectively is known collectively as configuration status accounting. Configuration status accounting is defined in the RAAF as:

> the recording and reporting of the information that is needed to manage configuration effectively, including a listing of approved configuration identification, the status of proposed changes to configuration, and the implementation status of approved changes. (31:A-2)

By reporting or documenting the current configuration of a system or technical equipment, configuration status accounting ensures traceability of data is achieved throughout the life cycle (32: Chapter 24).

The definition of configuration status accounting suggests the first requirement is to obtain information about the documentation necessary for configuration identification. Although the functional configuration identification is the first configuration identification to be established, it is the product configuration identification that is used by HQLC personnel as the basis for describing the functional and physical characteristics of systems and items of technical equipment under their management control. The type record, plus any approved changes, forms the product configuration identification for

the item on delivery to the RAAF for operational use (32:Chapter 2). Thus configuration status accounting requires that a type record be assembled.

Information contained in the type record includes the Design Certificate and any of the following that may be applicable:

a. Master Record Index (MRI),

b. descriptive, packaging and installation data,

c. summaries of the assumptions on which the design is based,

d. weight information, and

e. list of test reports. (32:Chapter 4)

However, the primary element in the type record is the MRI which includes any of the following documents that may be applicable to the technical equipment:

a. Index of Components,

b. Index of Amendments and Modifications,

c. Index of Ancillary Equipment,

d. Index of Subsidiary Master Records, and

e. Drawing List. (32: Chapter 17)

The Index of Components lists all components as they were manufactured by the main contractor, or by any sub-contractors not having Design Authority. The Index of Amendments and Modifications is an index of all amendments and approved modifications that affect those items listed in the Index of Components. The Index of Ancillary Equipment lists any special-to-type tools and ground equipment, test

instructions or miscellaneous drawings required for in-service maintenance of the technical equipment. The Index of Subsidiary Master Records lists all components for which an MRI is already held by another firm having Design Authority (32:Chapter 17).

The MRI can be used in concert with appropriate amendment and modification sheets to:

a. check that the set of drawings and other documents associated with the technical equipment is complete and current,

b. give a list of all the drawings that will require amendment action following implementation of a configuration change, and

c. work backward from any given revision level of drawings to any previous revision level. (32:Chapter 17)

Thus the type record in general, and the MRI in particular, satisfies the objective of providing traceability of data throughout the life cycle.

Other documents are also associated with the technical equipment and are required to be traced through status accounting. RAAF configuration management procedures require contractors provide all material necessary for the production of appropriate RAAF publications. Depending on the contract, material may be delivered either in the form of RAAF publications, or in sufficient form to facilitate

in-house production of RAAF publications. RAAF publications include, but are not limited to, the following:

a. flight manual,

b. operator's manual,

c. maintenance and overhaul manual,

d. Technical Maintenance Plan (TMP)

e. illustrated parts breakdown (IPB),

f. wiring diagrams, and

g. installation manual.

On delivery, the material is required to reflect the currently approved configuration. Moreover, they are to be amended to ensure they remain current and in concert with approved changes in configuration. (32:Chapter 22; 39:Chapter 1)

In addition to recording the configuration identification, configuration status accounting also requires recording and reporting action on proposed and approved changes. HQLC has established a section, the Modification Recording and Reporting Section (MRRS), which has responsibility for recording information relevant to proposed and authorized modifications on a computer databank (37:Chapter 1; 39:Chapter 6). Additionally, status of approved changes that have been issued as Modification Orders can be tracked when a modification has been implemented, since personnel are required to advise HQLC in accordance with the instructions on the Modification Order. (32:Chapter 19; 38)

Configuration Audit

Configuration audits are required to ensure the configuration processes are being carried out correctly. In particular, regular audits will ensure the configuration of a system or technical equipment is in accordance with its associated configuration identification. (28:1)

Configuration audits are used during product development and production to verify compliance with specifications and other contractual requirements. Current RAAF configuration policy states that two kinds of audits are performed, namely the functional configuration audit (FCA) and the physical configuration audit (PCA) (31:Annex A)

The RAAF has adopted the US DoD definition of a FCA as follows:

> The Functional Configuration Audit (FCA) is a formal audit to validate that the development of a configuration item has been completed satisfactorily and that the configuration item has achieved the performance and functional characteristics specified in the functional or allocated configuration identification. In addition, the completed operation and support documents shall be revised. (31:A-1; 15:6)

This definition suggests the objective of an FCA includes a check to ensure that the item's actual performance and functional characteristics are in accordance with the intended performance and functional requirements necessary to satisfy the mission need or operational requirement. Continuing the US DoD approach, FCAs will normally be carried out on the prototype or preproduction

item if it exists, or otherwise on the first production item (15:71).

The RAAF has also adopted the US DoD definition of a PCA to as follows:

> [A PCA] is a technical examination of a designated configuration item to verify that the configuration item 'As-Built' conforms to the technical document which defines the configuration item. (31:A-1; 15:6)

Additionally, the PCA is used to establish the item's product baseline.

While RAAF configuration management procedures do not directly refer to the requirements of configuration audits, procedures covering design, development, testing and production are intended to effectively include all of the audit functions necessary to validate compliance with the specification (32:Chapter 24). As an example, approval of the type record is a form of configuration audit.

FCAs and PCAs seem to be specifically related to the development and production phases of the life cycle. Further, there does not seem to be a specific term used for those configuration audits that are required on a regular basis throughout the operational phase of the life cycle. Despite this apparent anomaly, procedures relating to in-service configuration audits should be specified in the applicable CMP(AF) and should be such that they ensure the system or technical equipment remains consistent with its associated configuration identification throughout the operational phase of the life cycle (28:1).

Objectives and Benefits of Configuration Management

The previous outline of configuration management illustrates that the decision to impose configuration management procedures on a system or technical equipment initiates several activities which ensure the system or technical equipment continues to meet the operational requirements throughout its life cycle. Moreover, inherent advantages of meeting configuration management objectives help HQLC staff to better meet their objective of providing logistics support to the RAAF.

Objectives of Configuration Management. The objectives of RAAF configuration management are as follows:

a. to introduce, at the appropriate time, the degree and depth of configuration control necessary for production and subsequent in-service support, yet allowing a reasonable degree of design and development latitude;

b. to maximize efficiency in the management of configuration changes with respect to need, resources, timing and implementation;

c. to contribute to the achievement and enhancement of standards of performance, operational effectiveness, safety, and availability of systems and equipment at minimum resource cost; and

d. to use common procedures, terms and definitions for configuration management within Defence and

between Defence and industry, where such use can be shown to improve efficiency. (31:2)

Benefits of Configuration Management. Successful configuration management will provide benefits throughout the life cycle of the system or technical equipment by ensuring that:

a. the configuration of systems and equipment for both operational and non-operational use is known;
b. verified and current configuration data is available when needed;
c. systems and equipment standardization and maintainability are maintained;
d. specifications, drawings and related data are adequate for configuration control needs;
e. the total performance, cost and schedule impact of proposed configuration changes are known before acceptance or rejection; and
f. pertinent physical and functional interfaces between systems, equipment and computer programs are documented and controlled. (31:2)

Case Study: RAAF Air Traffic Control Communication Systems

Problems being experienced with configuration management can be illustrated by considering Air Traffic Control (ATC) communications systems. Logistics engineering responsibility for ATC communication systems has been delegated to a section within the Directorate of

Telecommunications Engineering - Logistics Command (DTELENG-LC), namely TELENG2B.

TELENG2B is divided into two sub-sections. The first has responsibility for operational system support for ATC communications systems while the second is responsible for ATC communication systems projects. The operational system support sub-section performs activities aimed at ensuring the ATC communications system continues to meet existing operational requirements, while the project sub-section performs activities aimed at extending or revising existing operational capabilities.

Current ATC communication systems can be categorized into one of two basic types: digital or analogue. Digital tower systems have been installed at RAAF Base Tindal (the 'AWA system') and at RAAF Bases Richmond and East Sale (the 'REA system'). All other RAAF ATC towers use analogue technology, based predominantly on the AF/GIC-804 audio distribution system.

The AF/GIC-804 System. The AF/GIC-804 ATC tower communication system has a name reflecting its equipment-type designator as defined in MIL-STD-19D. This system was installed during the 1970s and is currently used in seven RAAF ATC towers. The AF/GIC-804 system is based on relay technology and uses analogue control techniques to effect switching of analogue audio signals among a complicated network of hardwired cable connections.

The REA System. The REA ATC tower communication system is commonly known by a name reflecting the company responsible for installing the system. The REA system, which is characterized by digital control of analogue audio signals, was installed during the latter half of the 1980s by reworking existing ATC towers at RAAF Bases East Sale and Richmond. Although the systems have been operational since installation was completed, formal transition to HQLC from Air Force Office has been delayed pending resolution of several issues, including an investigation of unresolved system defects (21).

The AWA System. The AWA ATC tower communication system is commonly known by a name reflecting the company responsible for installing the system. The AWA system, which is characterized by digital control of digital audio signals, was installed under the management of Air Force Office in a new ATC tower built for the RAAF in the late 1980s.

System configuration changes are generated by several sources. The most common are projects sponsored by Operator Requirements staff in Air Force Office to install new facilities meeting changing operational requirements. These projects are managed as Ground Telecommunications Installations (GTIs). Other changes result from the need to maintain the existing operational requirements and are managed as system modifications. Modifications are raised for reasons that include: replacing obsolete equipment;

rectifying system defects; or improving operational use, effectiveness, reliability, or safety. While system modifications and projects are each subject to RAAF configuration management procedures, additional guidelines are given for projects in Telecommunications Division Routine Instructions (35).

Modifications and GTIs are designed by TELENG2B System Engineers (SYSENGs). SYSENGs are not always able to conduct site surveys due to cost restrictions on travel. Hence they must rely on the relevant ATC system publications when designing configuration changes to remote facilities. Since TELENG2B is responsible for engineering management of ATC communication systems, master copies of relevant publications are held within the section. However, TELENG2B staff are aware that ATC communication system publications are incomplete and/or inaccurate.

Two separate TELENG2B investigations have been carried out to investigate reasons for inaccurate and/or incomplete documentation. The first was a section Quality Circle (QC) investigation (19) and the second was conducted by the operating system support sub-section (18). In addition, a HQLC Process Action Team (PAT) investigated the HQLC publication amendment process (49).

Quality Circle Investigation

The TELENG2B QC team investigation into inaccurate and/or incomplete ATC communication system publications was

actually a by-product of another investigation concerned with identifying causes for delays in completing projects. The QC investigation confirmed a backlog in ATC communications system projects which was further exacerbated by manpower vacancies and high manpower turnover rates. The backlog in projects prompted a shift in priority of actions performed by SYSENGs. In particular, SYSENGs afforded a higher priority to completing installations needed to meet new operational requirements, but at the expense of temporarily forgoing post-installation activities. One of the post-installation activities forgone involved submitting publication amendment data to update the configuration identification. Since amendment data was not being submitted, publications and other documents were not being maintained in concert with configuration changes to the system itself. On occasions, SYSENGs responsible for new installations were reassigned without submitting required amendment data. (19)

DTELENG Publications Sub-section Investigation

TELENG2B operating system support sub-section includes a group having responsibility for processing data submitted to amend the ATC communication system configuration identification, including ATC system publications. Data is submitted from those TELENG2B SYSENGs effecting changes to ATC communication system configuration, whether from modifications or from projects. Raw data is prepared and

processed sufficiently to be transferred as master amendment documents to a HQLC Branch responsible for mass reproduction and distribution of RAAF documentation. The operating system support sub-section has an on-going commitment to investigate sources of inaccurate and incomplete publications.

One investigation was prompted over concern about data backlog and delays in preparing the raw data. The investigation found the backlog consisted of approximately 280 separate publication amendment tasks affecting ATC communication system publications. Some of the amendment tasks dated back nearly ten years to the early 1980s. The investigation found the backlog was due in part to the practice of employing field technicians, who generally lacked typing skills, as data entry operators. The investigation further found that delays were caused by inefficient work practices, such as repetitive keying of the same data. Backlog and processing delays caused subsequent delays to publication amendments and contributed to inaccurate configuration records. (18)

In another investigation, operating system support staff found certain data was not supplied to the RAAF. For example, system publications for the REA towers at RAAF Bases Richmond and East Sale had not been supplied to the RAAF, despite being operational for more than two years. Additionally, some of the data was not intended for delivery to the RAAF, and this had prevented effective investigation

of certain defects (for example, see 17). While many publications were missing data, many included obsolete data which referenced redundant facilities removed earlier (in some cases years earlier). (18)

PAT Investigation

The PAT investigation was initiated in response to overall delays in the publication amendment process within HQLC. While this investigation was inconclusive and recommended further investigations, an early indication was that personnel were unfamiliar with the documented procedures required to process publication amendments and that inefficient work practices further contributed to delays (49).

On-Site Reviews

TELENG2B is responsible for the engineering integrity of all ATC communications systems. To meet this responsibility, staff from the operating system support sub-section periodically visit each site. The aim of these visits is to liaise with unit technical personnel to determine problem areas and also to check for any configuration anomalies. Configuration anomalies have been found at every base and typically fall into one of three basic categories:

a. a project or modification has been carried out, and the corresponding amendment data has been submitted to update the configuration record, but

the production and distribution of the publication amendment to the units was delayed; or

b. a project or modification has been implemented, but the corresponding amendment data has not been submitted; or

c. an unauthorized configuration change has been implemented by unit personnel. (for example, 4; 6)

Effects on Logistics Engineering Support

The case study material suggests TELENG2B configuration management problems begin with incomplete configuration identification since sufficient relevant information was not provided to facilitate execution of responsibilities. The problems continue with poor configuration control since unauthorized changes have been implemented and control over system data has been lost. Finally, configuration status accounting is ineffective since SYSENGs are unable to determine current configuration and can not work backwards to determine previous states.

Ramifications of inadequate configuration management procedures include the following:

a. Design activities for projects and modifications are delayed while SYSENG check accuracy and completeness of the system documentation. Alternatively, SYSENGs might conduct on-site design activities. However, this might incur unnecessary travel expenditure. Where pre-design

checks are not performed, the SYSENG risks having to conduct on-site redesign activities during the installation phase to adjust for differences between expected and actual configuration. Meanwhile, the valuable time of the installation team is wasted. Moreover, redesign is seldom successful, since additional hardware and/or software is normally required. The ultimate effect is that urgently needed operational requirements are not satisfied when needed.

b. Operating system support actions (such as investigating defects, designing modifications, responding to unit requests for assistance, or deciding on replacement items for obsolete components) are often delayed, or otherwise rendered ineffective, while publication information is verified.

c. Field technicians are not able to carry out effective scheduled maintenance or system fault diagnoses. Additionally, since ATC operations are generally kept on-line during fault diagnosis, maintenance action by technicians relying on inaccurate and incomplete system documentation has the potential of compromising safety standards and causing serious harm to personnel or equipment.

The case study only presents a view from one section within HQLC. The problems being experienced by TELENG2B

might be limited only to them. However, other sections have also reported problems caused by inadequate configuration management. A conclusion might therefore be drawn that still more HQLC sections may be experiencing problems with inadequate configuration management.

Reports From Other HQLC Sections

Problems of inadequate configuration management have been reported from SYSENGs responsible for logistics engineering support of the Australian version S-70A-9 Blackhawk (3; 24) and have prompted a request for support as a potential topic for further research by RAAF officers undertaking post graduate studies in logistics management (23).

The concern is based primarily on differences in configuration detected between successive aircraft delivered to the RAAF. The anomalies are believed to have originated during production when the baseline had not been established, yet production continued. Further, the aircraft designer is believed to have introduced on-going production improvements to all airframes during production. In both cases, HQLC SYSENGs are unaware of the extent of the differences in configuration and are now faced with two requirements. The first is to identify all major differences in the S-70A-9 fleet, and the second is to introduce a programme to modify the aircraft as appropriate to achieve essential commonality of design. (24)

Problems with configuration management of the F/RF-111C Weapon System were also identified by a RAAF officer engaged in postgraduate research at the US Air Force Institute of Technology (2). This research found that, in general, configuration management of the F/RF-111C was performed on an exception basis. As an example, although many configuration changes were accomplished after delivery of the aircraft in the mid-1970s, the configuration record was only realigned with the physical configuration during 1988-9 in preparation for the Avionics Update Programme (AUP) configuration baseline. In addition, the research reports several occasions where superseding components or equipments had been introduced into operational service without revisions to the documented maintenance procedures or the IPB. (2:65-67)

Relevance of Literature Review to Research

Emory's question hierarchy is a useful way of approaching the research process (20:77). When the survey is used as the primary data collection instrument, measurement questions are those actually asked of the respondents.

The literature review was the basis for developing measurement questions used in the survey to collect research data. The description of configuration management and associated RAAF policy and procedures was used to develop measurement questions associated with the first

investigative question, while the case study and reports from other sections was used the develop measurement questions associated with the second and third investigative questions.

Summary

Configuration management is an approach used to support the management of systems and technical equipment throughout their life cycle. Application of configuration management principles ensures a system or technical equipment is developed and produced to comply with the intended operational requirement. Configuration management is applied throughout the life cycle to ensure the system or technical equipment continues to satisfy the operational requirements, despite any changes that may evolve.

Configuration management involves three basic processes, namely configuration identification, configuration control, and configuration status accounting. Configuration audits are also associated with the configuration management process.

In simplistic terms, configuration identification is the technical documentation used to describe the system or technical equipment. Having obtained a description, configuration control ensures that only authorized changes are made and that the configuration identification is amended in concert with any changes in both physical or functional configuration. Configuration status accounting

is used to ensure all necessary data for configuration management is collected and reported and also ensures traceability of configuration status throughout the life cycle.

Although RAAF configuration management policy and procedures are distributed among several documents, a CMP(AF) is intended to document the extent to which configuration management is to be applied to a particular system or technical equipment.

A case study investigation demonstrated problems with inadequate configuration management that are being experienced by at least one section within HQLC LOGENG Branch. Other sections have also reported problems with inadequate configuration management. These problems have had the consequence of contributing to declining engineering logistic support to the RAAF.

III. Research Methodology

Overview

The objective of this research was to provide insight into configuration management at HQLC by determining whether current configuration management practices within HQLC LOGENG Branch have any impact on HQLC's ability to provide engineering logistics support to the RAAF. To achieve this objective, the research was broken into three phases.

The first phase was undertaken in two parts. The first part reviewed contemporary RAAF configuration management policy and procedures, while the second part investigated problems and consequent effects experienced by select HQLC sections due to inadequate configuration management. The second phase involved collecting necessary data to answer the research objective using information gained from phase one to focus on what data was required. The third phase analyzed data collected from phase two and used the results as the basis for conclusions drawn and recommendations made.

The remainder of this chapter provides further detail on the methodology used to answer the research objective. The chapter begins by introducing the general research methodology and continues with a discussion of the choice and justification of the research instrument. The chapter includes an outline of the approach used to develop and test the research instrument and also a description of the

population and sample. Limitations of the research methodology are discussed. The chapter concludes with a brief discussion of administrative considerations and a summary.

General Research Methodology

The case study investigation revealed that at least one section within HQLC claims that inadequate configuration management is impacting their ability to provide engineering logistics support. The literature review also reported similar claims made by other sections within HQLC. These claims can be represented by the cause and effect diagram at Figure 4, which shows a basic cause block (block 1) and the resulting effect block (block 2). Figure 4 can be read as follows:

> *If* a section has inadequate configuration management of their system or technical equipment, *then* inadequate logistics engineering support is provided to the RAAF.

While Figure 4 represents the perspective of a single section within HQLC LOGENG Branch, the concept can be extrapolated to represent the view of HQLC LOGENG Branch as a whole. Using this approach, the logic of Figure 4 can be expressed as follows:

> *If* HQLC LOGENG Branch has inadequate configuration management, *then* HQLC LOGENG Branch will provide inadequate logistics support to the RAAF.

The approach taken in the research was guided by the so-called "categories of legitimate reservation" which are used to scrutinize logic diagrams (22). The logic of figure

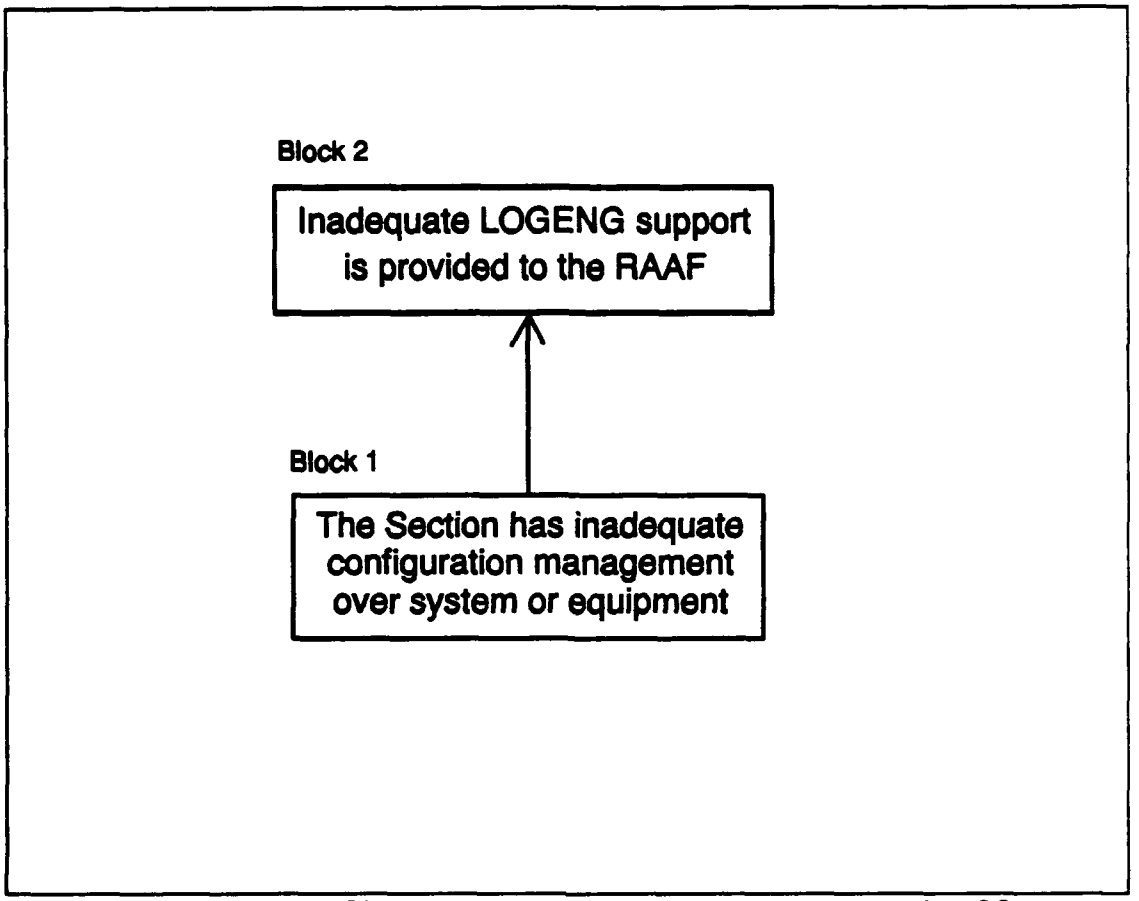


Figure 4: Configuration Management Cause and Effect Diagram

4 was tested from a HQLC perspective. In particular, the research investigated the existence of the cause at block one of Figure 4 by asking the following investigative questions:

Investigative Question 1. Are configuration management procedures being used?

Investigative Question 2. Is inadequate configuration management being experienced?

The research then investigated the existence of the effect at block two of Figure 4 by asking the following investigative question:

Investigative Question 3. Is there any impact on engineering logistics support capability?

The investigative questions were answered by developing a data collection instrument which addressed relevant measurement questions. The measurement questions were formulated using the knowledge gained from the literature review. The review of RAAF configuration management policy and procedures determined measurement questions associated with the first investigative question while the case study and reports from other sections determined appropriate measurement questions associated with the second and third investigative questions.

Research Instrument - Selection

As the research involved collecting data from HQLC located in Melbourne, Australia, only two research instruments were considered, namely telephone survey and mail survey.

Dillman suggests selection of the most appropriate method is made only by evaluating the particular circumstances of the survey environment. Factors include: the topic of study, the population to be surveyed, and the precise survey objectives. (16:39)

According to Emory and Cooper, the selection "is not as complicated as it might first appear" (20:337). They provide a convenient table for comparing relative strengths and weaknesses of each method (20:338-339). The criteria from this table were used to make the following evaluation:

a. Both mail and telephone surveys can accommodate the remote distance of the researcher from the population, but a mail survey accomplishes this at less cost.

b. A telephone survey requires skilled interviewers while a mail survey requires minimal staff. Neither skilled interviewers nor staff were available to the researcher.

c. A mail survey gives the respondent more time to consider answers, while a telephone survey must be limited in time.

d. A phone survey gives a faster completion time and can access hard-to-reach respondents through repeated call-backs.

e. A mail survey has a lower response rate compared to telephone interviews.

f. An interview allows for probing for more further explanation of responses.

g. Respondents to a telephone survey often represent the extremes of the population.

In addition to the above criteria, telephone access to potential respondents was limited by the time difference between Melbourne and Wright-Patterson AFB. Having evaluated all criteria, a mail survey was chosen as the preferred survey instrument. The next task was to develop the survey where each question in the survey was actually a

measurement question associated with a particular investigative question.

Research Instrument - Development and Pretesting

While developing questions for a mail survey might seem a trivial exercise, this proved to be a difficult task in practice. Authors are quick to highlight the dangers of not affording proper attention to questionnaire design (for example, see 16:95-117; 20:333; 5:157-172; 1:23-41). Moreover, even when the questions are without fault, the questionnaire designer is warned of the likelihood of poor response rate (20:333; 1:42). Despite their inherent difficulties, questionnaires are widely used survey instruments (1:1).

Reference was made to several texts for guidance on preparing the questionnaire (16; 20; 5; 1). In particular, guidance was sought on question construction and survey layout. It was also important to construct a survey instrument which would minimize the number of non-respondents. Berdie and others suggest a general strategy is to anticipate the possible reasons for people not wanting to participate in the survey (1:45).

DGELS-LC had initiated action early in 1992 to develop CMPs(AF) for each of the systems and technical equipment managed by HQLC (48). This could potentially discourage respondents from participating in the survey, or from providing frank responses. Accordingly, a covering letter

was prepared which advised survey respondents that returns would be kept confidential. A copy of the after-pretest covering letter is included at Appendix C. A system of codes was utilized which allowed respondents to remove their name and personal details from the survey as soon as it was received. Only the researcher and the HQLC liaison officer had access to the decoding list, which was destroyed when the research was completed. However, full confidentiality could not be guaranteed since the researcher had been assigned to HQLC for more than five of the most recent six years and was known personally to many of the potential respondents. Accordingly, respondents may have been reluctant to be entirely frank with the researcher. This was potentially a greater problem since the survey was designed to seek a respondent's answers to questions on a topic where it was expected that little knowledge existed. The survey covering letter included a statement assuring respondents that the survey was not intended to be a test of individual knowledge.

Specific survey questions were designed for each of the investigative questions. For the first investigative question, the objective was to ask those questions which would establish whether configuration management procedures were being used. For this purpose, more specific investigative questions were asked as follows:

> Investigative Question 1a. Does the person know what configuration management is?

Investigative Question 1b. Is the person familiar with RAAF configuration management policy and procedures?

Investigative Question 1c. Are the elements of configuration management and configuration audits being utilized?

Survey measurement questions were identified using the more specific investigative questions and the review of RAAF configuration management policy and procedures as a guide.

For the second investigative question, the objective was to ask those questions which would establish whether inadequate configuration management was being experienced. The problems identified in the case study investigation and reports from the other HQLC sections were used as the basis for selecting survey questions. In particular, the measurement questions sought to determine whether the respondent had experienced similar problems.

For the third investigative question, the objective was to ask those questions which would establish whether configuration management procedures were having an impact on engineering logistics support capability. In particular, the measurement questions sought to determine whether the respondent had experienced effects on engineering logistics support similar to those identified in the case study investigation and reports from other HQLC sections.

The subsequent draft survey is included at Appendix D. The draft survey was subjected to a pretest using eight RAAF officers stationed at Wright-Patterson AFB. Of the eight, seven were officers from the Engineering Branch and the

other was an officer from the Supply Branch. Most had recent HQLC LOGENG experience. The pret : led to several changes to the survey itself and also to the covering letter. For the survey, the most significant change resulting from the pretest was to include an open-ended question to give respondents the opportunity to comment on configuration management problems being experienced. With regard to the covering letter, pretest comments suggested reinforcing the advice to respondents that the research was being conducted independently of the DGELS-LC initiative for CMPs(AF). This advice was based on the belief that the survey was to be released coincident with a major milestone of the DGELS-LC initiative.

The final survey is included at Appendix E. This sample survey is not an exact duplicate for two reasons:

a. Australian standard paper is larger and accommodates more text per page, and

b. the survey was reformatted to conform to the research report document.

Population and Survey Sample

Population. The population consists of engineering and technical personnel from the HQLC LOGENG Branch. Of the sections within this Branch, 12 were identified as having engineering logistic support responsibilities for specific systems and technical equipment. Specifically, the 12

sections, including a simplistic description of associated responsibilities, are as follows:

a. Aircraft Engineering Section 1 (AIRENG1) responsible for various aircraft airframe structures and engines.

b. Aircraft Engineering Section 2 (AIRENG2) also responsible for various aircraft airframe structures and engines.

c. Hornet Engineering Section (HES) responsible for the F/A-18 Hornet.

d. Weapons Engineering Section 1 (WEAPENG1) responsible for aircraft weapon systems.

e. Weapons Engineering Section 2 (WEAPENG2) also responsible for aircraft weapon systems.

f. Aeronautical Equipment Engineering Section 1 (AEENG1) responsible for aircraft instruments, inertial navigation systems and flight control systems.

g. Aeronautical Equipment Engineering Section 2 (AEENG2) responsible for aircraft electrical systems.

h. Aeronautical Equipment Engineering Section 3 (AEENG3) responsible for aircraft radar and communications systems and navigation aids.

i. Aeronautical Equipment Engineering Section 5 (AEENG5) responsible for ground mechanical systems.

j. Aeronautical Equipment Engineering Section 6 (AEENG6) responsible for Ground Support Equipment, automatic test equipment (ATE), and other test equipment.

k. Telecommunications Engineering Section 2 (TELENG2) responsible for ground radar systems and Air Traffic Control communication systems.

l. Telecommunications Engineering Section 3 (TELENG3) responsible for point-to-point communications systems.

Current organizational diagrams were used to identify LOGENG Branch personnel belonging to each section within the population.

Sample. Each person in the population below the rank of Wing Commander (to exclude Branch Directors and section commanders) was assigned a code number to facilitate random sample selection, confidentiality, and data analysis. The sample consisted of 30% of the population by selecting a stratified random sample. The population was divided into strata according to sections described above.

Limitations of the Research Methodology

The research question would ideally be answered by collecting quantitative data for rigourous mathematical analysis. However, the research was essentially a descriptive study and relied on the respondents' beliefs in their answers to the measurement questions as the primary

basis for analysis. The beliefs were analyzed by subjectively considering the contribution of the associated measurement questions to the relevant investigative questions. The investigative questions were used in turn to answer the research question. As a consequence, the research was limited by the degree to which subjective analysis could be used to draw valid conclusions about the investigative questions.

When analysing the reponses, only those factors relevant to configuration management that were identified from the case study and other literature review material were considered. However, there are likely to be several other factors which also contribute to successful application of configuration management. For example, when evaluating responses from individual sections, no account was taken of the differences in complexity among the various systems or technical equipments managed by these sections.

The research did not establish the degree of any adverse effect of current configuration management procedures on HQLC's ability to provide engineering logistics support. Rather the research only established whether any adverse logistics support exists.

A fourth limitation is that the researcher is not a trained author of survey questions, despite the guidance provided in the reference material. As a consequence, there is a likelihood that at least some of the questions are poorly written.

Administrative Considerations

Preliminary approval was obtained from DGELSS-LC to conduct the survey within his Branch. Further approval was obtained to nominate a HQLC liaison officer to distribute and collect the survey, and also to act as the primary point of contact for any queries.

Summary

This chapter describes the research methodology used to answer the research question and corresponding investigative questions. The basic methodology was to divide the research into three phases. The first phase involved a literature review and a case study and was described in Chapter II. The next Chapter describes the second and third phases which cover data collection and data analysis respectively. Conclusions and recommendations are presented in Chapter V.

IV. Findings and Analysis

Overview

This chapter presents the research findings and an analysis of the survey data used to support these findings. The chapter begins with a discussion of the response rate and continues by analyzing survey data collected to answer each investigative question. Problems encountered in analyzing the data are also discussed as appropriate. Answers to the investigative questions are used in aggregate to answer the research question. The chapter concludes with discussion of general considerations and a summary.

Survey Response Rate

Of the 104 surveys sent to selected personnel, 89 were returned giving an initial response rate of 86%. However, not all of the returned responses were used for the analysis. The disposition of the returned survey is as follows:

Number returned and analyzed	74
Number returned, lost in transit	12
Number returned, ruled non-response	2
Number returned, ruled ineligible	3
Total returned	89

As indicated, 12 responses were returned to the HQLC liaison officer, but were lost in transit between Melbourne and Wright-Patterson AFB. Additionally, two surveys

returned incomplete were ruled as non-responses since the respondents did not have valid reasons for not completing all sections of the survey. Three surveys were returned complete, but were subsequently ruled ineligible. Their job description information revealed that their duties were in clerical support and not directly related to any engineering function.

Dillman suggests a common procedure for calculating response rate is to eliminate ineligible and unavailable respondents from further consideration (16:50). Using this method:

Number returned	74
Number ineligible (*)	15
Number unavailable (#)	8

(* 3 ruled ineligible plus 12 lost in transit)

(# absent on duty or discharged from the RAAF)

This method yields a response rate of 89%, which compares favourably with a response rate of 30% which is often considered satisfactory (20:333).

Effect of Responses on Sample Bias. As described in Chapter III, a stratified approach was used to determine an appropriate sample. The effect on sample bias of those surveys either not returned, ruled ineligible, or lost in transit, has not been determined.

Investigative Question 1

The purpose of the first investigate question was to determine whether configuration management procedures were being used. This question was answered by asking three more specific investigative questions, each of which were addressed in the survey.

Investigative Question 1A

Investigative Question 1A sought to determine if respondents knew what configuration management is. Survey questions relating to configuration management principles and elements were asked.

The majority or respondents (92%) agreed they understood the principles of configuration management. This figure remained consistent across each of the sections, with the exception of AEENG6 (67%) and TELENG3 (60%).

The number of respondents who agreed they could identify the elements of configuration management decreased to 67%. Again this rate was consistent across all sections with the exception of HES (100%), AEENG1 (45%) and TELENG3 (40%).

The results are not entirely unexpected. Principles of configuration management might be expressed in simple terms as the management of changes to both the physical build of a system or technical equipment and the associated documentation. Much of the RAAF procedural documentation, particularly that used by HQLC personnel, is restricted to

these issues; LBRIs cover procedures for configuration control (26) and management of modifications (37). However, an understanding of the elements of configuration management requires a more detailed understanding of configuration management itself. Although RAAF policy and procedures cover some aspects of configuration management in detail (such as change control), other elements (such as configuration identification) are given little direct attention.

The results for TELENG3 might have been anticipated since the non-aircraft engineering elements may have historically paid little attention to the rigours of configuration management. Similarly, respondents from HES are involved with a relatively new weapon system (F/A-18 Hornet) and configuration management procedures are more likely to be applied to such a weapon system.

Investigative Question 1B

Investigative Question 1B sought to determine if respondents are familiar with configuration management policy and procedures. Initial questions asking respondents to state if they knew where policy and procedures were promulgated were verified with later questions asking respondents to state where they were promulgated.

Of the 72 respondents, 41 (57%) agreed they knew where configuration management policy is promulgated, while 18 (25%) did not know; 11 (15%) could neither agree nor

disagree, or had not decided. Several of the respondents listed procedural documents instead of policy documents so that of the 41 respondents who agreed they knew where configuration management policy is promulgated, only 12 (29%) could correctly state where. Thus only 12 (17%) of the 72 respondents know where configuration management policy is promulgated.

Of the 72 respondents, 41 (57%) agreed they knew where configuration management procedures are promulgated, while 15 (21%) did not know; 13 (18%) could neither agree nor disagree, or had not decided. These results are almost identical to the results obtained for promulgation of policy. Of the 41 respondents who agreed they knew where configuration management procedures are promulgated, only 27 (66%) could correctly state where. Additionally, another four respondents correctly indicated where configuration management procedures are promulgated, giving a total of 31 (43%) of the 72 respondents who know where configuration management procedures are promulgated. Several of the respondents listed LBRIs as a source of procedural documents. Although LBRIs contain some configuration management procedures, these are confined to a limited view of configuration control (26) and management of modifications (37; 39).

The confusion between policy and procedural documents may be insignificant. However, the policy documents outline when configuration management procedures are applicable to a

system or technical equipment; this may not be apparent from the procedures alone. Accordingly, configuration management procedures may not be applied to all intended systems and technical equipment.

Further questions were used to ask respondents whether the policy and procedures were useful to them and easy to read. 31 (43%) and 35 (49%) respondents stated that the policy and procedures respectively were useful while only 23 (32%) and 24 (33%) thought the policy and procedures respectively were easy to read. These responses need to be considered in concert with the accompanying comments, a sample of which is included at Appendix G. In part, these comments suggest the policy and procedures are vague, complex, and difficult to understand without some prior configuration management knowledge. Further, the policy and procedures are too fragmented, being spread over too many publications which are sometimes contradictory. Moreover, the policy and procedures are oriented toward the early part of the life cycle, and not to the in-service phase.

Investigative Question 1C

Investigative Question 1C sought to determine if elements of configuration management and configuration audits were being used by HQLC LOGENG staff. To answer this question, the survey included several questions addressing various characteristics of the elements of configuration management and also of configuration audits.

Although a majority of respondents (85%) agreed configuration management was relevant to their Major Item of Technical Equipment (MITE), fewer (71%) agreed configuration management was being applied, with only 28% of respondents agreeing that a configuration management specialist had been appointed for their respective MITEs. Moreover, a configuration management specialist was less likely to be appointed in the aeronautical equipment engineering (14%) and telecommunications Directorates (17%). Only 35% of the total respondents agreed their configuration responsibilities had been well defined, with the majority of those coming from the aircraft and weapons engineering Directorates. Specifically, none of the respondents from AEENG1 or TELENG3 agreed their configuration management responsibilities were well defined, although 78% of AEENG1 respondents were undecided.

The majority of respondents (96%) agree their respective MITEs would require on-going logistics support, such as spare part provisioning and maintenance. This was consistent among all sections. However, the initial assessment of configuration management characteristics indicated that general configuration management procedures are more likely to be applied in the aircraft and weapons engineering Directorates. Moreover, the aeronautical equipment and telecommunications engineering Directorates were more likely (62% compared with 24%) to introduce more of their respective MITEs into service, despite having

apparently less understanding of configuration management procedures.

Configuration management is to be applied to all configurations items in the RAAF (28:2). From a HQLC LOGENG perspective, 58% of respondents agreed configuration items had been identified for their respective MITEs. However, this was not consistent among individual sections. While 88% of respondents from the aircraft and weapons engineering Directorates agreed configuration items had been identified, only 22% from the aeronautical equipment and telecommunications engineering Directorates agreed. In particular, 29% of TELENG2 respondents and 0% of TELENG3 respondents agreed that configuration items have been identified for their respective MITEs.

From a configuration identification perspective, only 22 (31%) respondents agreed that formal configuration baselines had been established. However, this rate was not consistent across all sections. None of the respondents from the non-aircraft sections (AEENG5, TELENG2, and TELENG3) agreed that formal configuration baselines had been established for their MITEs. Similar results were obtained for the issuance of type records and Design Certificates. Despite the lack of formal baselines, 50 respondents agreed sufficient documentation exists to ensure necessary logistic support activities (such as identification of spares and maintenance procedures) can be carried out during the life cycle of their respective MITEs. For example, 48 (68%)

respondents agreed they had access to documentation describing form, fit, and function and 52 (72%) respondents agreed they had access to a full set of technical documentation, such as specifications, operating and maintenance procedures, and spare parts list.

From a configuration control perspective, 49 (68%) respondents agreed a formal system exists to propose changes to the configuration of a system or technical equipment. Moreover, 47 (65%) respondents agreed a formal system has been established to approve proposed configuration changes. However, only 22 (31%) agree a system is in place to ensure approved configuration changes are incorporated on schedule. Analysis of individual sections indicate this is particularly true for sections from the aeronautical and telecommunications engineering Directorates, with 0% from AEENG2, 25% from AEENG3, 14% from TELENG2, and 20% from TELENG3 agreeing a formal system existed to implement changes to configuration on time.

The majority of respondents (89%) agreed they have made changes to their respective MITEs that require amendment to associated documentation. Subsequent configuration status accounting actions should ensure that affected publications are amended to reflect the changes. However, only 30 (42%) respondents agreed the technical documentation accurately reflects the configuration of the MITE. Additionally, only 33 (46%) respondents agreed the historical records are maintained sufficiently to allow determination of the

configuration status of their respective MITEs at any given point in time during its life cycle.

Configuration management procedures are implemented for a given system or technical equipment through a CMP(AF). However, 23 (32%) respondents reported they do not have a CMP(AF) for their MITE. 7 (10%) respondents report their CMP(AF) has been implemented for less than 6 months, which was probably due to a DGELS-LC initiative requiring CMPs(AF) for all HQLC LOGENG MITEs (48). In compliance with this initiative, several respondents reported that although a CMP(AF) does not currently exist, it is currently in draft form with imminent release expected.

Only 4 (6%) respondents reported the CMP(AF) had existed since the MITE was introduced into service. 27 (38%) respondents reported they did not know how long their respective CMPs(AF) had existed. These responses implied that, although a CMP(AF) existed, its currency was not known. This figure is higher than expected. However, respondents may have adopted a different interpretation of a poorly written question. Specifically, respondents were not given an option to report whether or not they knew if a CMP(AF) existed. Such respondents might have selected the "not known" response as the one more closely linked to their thoughts.

Configuration audits identify anomalies between the system or technical equipment and the configuration identification. However, only 21 (29%) respondents agreed

that a comparison between the as-is MITE and the documentation had been carried out in the most recent two year period. From an analysis of individual sections, only in HES (at 80%) did a majority of respondents agree that audits have been conducted. By comparison, AIRENG1 (at 14%), AEENG6 (at 6%), TELENG2 (at 14%) and TELENG3 (at 0%) were less likely to have conducted an audit.

Investigative Question 1 - Revisited

The responses to the more specific investigative questions indicated that, although configuration management procedures are considered necessary, no one section has adopted all of the configuration management procedures. Those configuration management procedures that have been adopted appear to have been adopted to comply with specific procedural instructions rather than by any particular effort to employ the whole configuration management package as the management tool it is intended to be.

While the analysis has been undertaken on the specific survey measurement questions, comments from respondents provide further insight into the use of configuration management procedures. Specific comments are provided in Appendix G. The comments suggest configuration management involves time consuming activities traditionally subordinated to other engineering activities which give more immediate and visible attention to the user ("fighting bushfires" or "crisis management" philosophy). Moreover,

long term neglect of configuration management procedures now requires considerable effort and resource investment before it can be brought to an adequate level of effectiveness. In addition, there has been little attention given to educating engineering and technical personnel about the virtues of configuration management and the subsequent benefits to effective engineering management.

Investigative Question 2

The first investigative question established that, although configuration management procedures are being used, they have not been adopted as a complete management package by any one section. The next step was to answer the second investigative question which sought to determine if those configuration management procedures that had been adopted were adequate. This was determined by investigating problems experienced. The survey included a series of measurement questions which asked respondents if they had experienced problems similar to those described in the case study investigation and also in reports from other sections.

As previously reported, the majority of respondents (89%) have made changes to their MITE that have required an amendment to associated documentation. Subsequent actions to amend the relevant publications ensures the configuration identification remains current. However, only 30 (42%) respondents report the technical documentation accurately reflects the configuration of the MITE. Of these 30, only 2

respondents reported the as-is configuration of the MITE is not known. Thus, there are 42 (58%) respondents who cannot agree the technical documentation is accurate, of which 19 also report the "as-is" configuration of fielded units is not known. Thus there appears to be a high correlation between having accurate technical documentation and knowing the as-is configuration of fielded units.

Inaccurate technical documentation might be due in part to delays in processing publication amendments, since only 42 (56%) respondents report publication amendments are issued within 12 months of implementing the configuration changes. Moreover, 47 (65%) respondents agree they experience delays in processing publication amendments.

Inaccurate technical documentation might also be due to publications amendments not being generated when required following a change in configuration of the MITE. This might be more common than first thought, particularly if there is no index to all the relevant publications, drawings and other documentation associated with the system or technical equipment. Only 29 (40%) respondents agree they have a list of relevant technical documents for their respective MITEs. Inexperienced personnel might therefore be unaware of publications requiring amendment. 28 (39%) respondents agree they are experiencing high manpower turnover rates (with a sample median of 13-24 months). However, respondents are split over whether section have no previous experience on the MITE. 34 (47%) of respondents agree staff

are more likely to be regarded as inexperienced because of having no previous HQLC experience. While the research did not establish any direct causal link between inexperience and publication amendments, the case study suggested that inexperience exacerbated the situation.

Publications might also be in error due to undocumented changes occurring during production. While this was reported in the literature review as a problem associated with the S-70A-9 Blackhawk, the survey results did not indicate the problem was common within HQLC. Only 5 (7%) respondents reported undocumented changes during production. Although a further 22 (31%) respondents did not know of any undocumented production changes, this does not automatically deny their existence. However, this also suggests that if undocumented changes did occur, they are not causing any apparent problems to LOGENG Branch.

In addition to the specific problems addressed, a general question indicated that 36 (50%) respondents believed inadequate configuration management practices had caused them problems in providing adequate logistics engineering support.

Investigative Question 2 - Revisited

The majority of respondents report inaccurate publications for their respective MITEs. Additionally, the majority of respondents report delays of amendments to publications, with amendments being issued in excess of 12

months after the configuration change has been implemented. Further, almost one quarter of the respondents report the as-is configuration of respective MITEs is not known. In addition to the specific problems experienced, half of the respondents reported they experience inadequate configuration management which had adverse effects on logistics support capability.

The survey results indicated that problems associated with undocumented production changes were not significant from a HQLC LOGENG perspective. However, absence of a widely experienced problem does not diminish its impact on logistics support capability in those cases where the problem does exist.

The foregoing suggests that problems experienced by TELENG2B seem to be characteristic of HQLC LOGENG as a whole, leading to the conclusion that HQLC LOGENG is experiencing inadequate configuration management.

Problems experienced by TELENG2B impacted on their ability to provide adequate engineering logistics support. The third investigative question investigated whether there is any impact on logistics support from the perspective of HQLC LOGENG.

Investigative Question 3

Although the first investigative question indicated that HQLC has adopted configuration management procedures (at least in part), the second investigative question

indicated that these practices are inadequate. The third investigative question sought to determine if there is any effect on HQLC's ability to provide logistics support. This was determined by investigating any significant effects of the inadequate application of configuration management procedures in HQLC LOGENG. The survey included a series of questions which asked respondents if they had experienced any of the effects reported in the case study.

Many of the effects reported in the case study reflect the important role configuration identification has in effective configuration management. The second investigative question also indicated poor documentation is a factor for most sections within HQLC LOGENG.

Technical documentation is a vital commodity to HQLC LOGENG personnel who are geographically remote from the systems and technical equipment they manage and who can not always travel to the field to carry out their investigations. However, 27 (38%) survey respondents reported the technical documentation does not correctly describe all fielded units. Additionally, 26 (36%) respondents reported their technical investigations (such as defect investigations, modification design, and investigations to provide support to users) have been delayed by inadequate documentation. Difficulties in evaluating proposals for changes to configuration are experienced by 23 (32%) respondents, with 25 (35%) reporting designs for modifications or other changes to configuration

might be incorrect. This requires rework with possible delays in task completion.

Besides the impact on engineering logistics support capability caused by inaccurate and/or incomplete technical documentation, 21 (29%) respondents reported the as-is configuration of fielded units was not known. As a consequence, 33 (46%) respondents reported delays in completing investigations and 27 (38%) respondents reported difficulties in evaluating modification proposals or other proposals affecting operation and/or maintenance. Moreover, since SYSENGs can not always perform a 100% check of fielded units prior to designing a configuration change, an inevitable consequence is that modification orders, and other instructions to implement configuration changes, may not be applicable to all field units. 32 (44%) respondents reported this effect was experienced.

In addition to implementing a change in configuration, action is required to update other relevant publications and technical documentation associated with the system or technical equipment. This documentation includes maintenance manuals and technical maintenance plans (including the maintenance policy). Yet problems with configuration management also have a corollary effect on field maintenance personnel with 40 (56%) respondents reporting field maintenance personnel may be using inaccurate or incomplete technical documentation to carry out maintenance activities. Moreover, 24 (33%) respondents

report maintenance policy decisions may also be based on inaccurate data, with 15 (21%) respondents reporting subsequent maintenance policies may not be applicable to all fielded units.

Investigative Question 3 - Revisited

Inaccurate and/or incomplete technical documentation, or not knowing the configuration of fielded units, were each causing delays to technical investigations and also difficulties in evaluating proposals for changes to configuration. Other effects on engineering logistics support were also being experienced.

As indicated in Chapter III, the study did not establish the degree of any adverse effects of current configuration management procedures. However, it did show that inadequate configuration management practices do affect HQLC logistics support. The survey results suggest the effects of inadequate configuration management are not confined to TELENG2B alone. Moreover, the survey only investigated those effects reported by TELENG2B. Additional effects characteristic of other systems or technical equipment are also likely to exist.

The analysis of the third investigative question suggests there is an impact on HQLC LOGENG engineering logistics support capability.

General Findings

This section discusses general problems encountered while conducting the analysis.

The research assumed respondents had no prior knowledge of draft policy and procedures. However, responses indicated that several respondents have provided comments on the draft procedures, namely DI(AF) AAP 7001.047 (29). Additionally, survey comments suggested that respondents involved in writing CMPs-AF have probably referred to the draft procedures for guidance. The consequential effects on the survey results have not been determined. However, these respondents are more likely to be familiar with configuration management policy and procedures than they may have otherwise been, so that the results represent an optimistic view.

Finally comments from respondents indicated that selection of a single MITE for the purpose of the survey was not always possible. This is known to have affected the survey results in at least one case, where the respondent chose that MITE which had fewer problems associated with inadequate configuration management. While this case leads to an optimistic conclusion, the actual impact on the results has not been determined.

Summary

This chapter presented the research findings and data analysis. The first investigative question indicated that

although configuration management procedures are being used within HQLC LOGENG Branch, they are not being used in the complete package as the management tool it is intended to be.

The second investigative question indicated that, based on the problems experienced by TELENG2B, configuration management procedures within HQLC LOGENG Branch are inadequate. The third investigative question indicated that problems being experienced with inadequate configuration management procedures would be likely to impact on engineering logistics support capability.

Combined, the three investigative questions provide an answer to the research question, namely that current configuration management procedures within HQLC LOGENG Branch have an impact on HQLC's ability to provide logistic support to the RAAF. The research did not attempt to determine the extent of the impact; it was intended to determine whether an impact existed.

V. Conclusions and Recommendations

Overview

This chapter presents the conclusions and recommendations of the research effort. The chapter begins by summarizing the results of the investigative questions which are used to answer the research question. The chapter concludes with researcher's comments and recommendations.

Conclusions

The research found that although configuration management procedures are being used, they appear to have been adopted piecemeal. Application of configuration management principles appears more likely to have been a result of complying with specific RAAF configuration management procedures, rather than any attempt at adopting configuration management as a fundamental and comprehensive engineering management tool.

The survey indicated a general lack of awareness of configuration management, and less than half of the survey respondents knew where configuration management policy and procedures are promulgated and fewer than one quarter agreed the policy and procedures are easy to read. This is supported by comments received which suggest the policy and procedures are too fragmented, are sometimes contradicting, and emphasize the early part of the life cycle rather than

the in-service phase which is of primary concern to HQLC LOGENG. Further, configuration management has suffered from long-term neglect and has often been subordinated to higher profile tasks. Moreover, technical staff have not been made aware of the virtues and benefits of configuration management.

The research found that all sections within HQLC LOGENG are experiencing similar problems, in varying degrees, to those identified by the case study and other reports. Although comments are included which suggest reasons for the problems being experienced, the research did not attempt to establish causes. However, the research supports the view that inadequate configuration management procedures are being utilized.

Yet, application of configuration management procedures is essential if engineering and maintenance elements of the RAAF are to effectively maintain systems and technical equipment so that they continue to meet the operational requirement. This statement is supported by the research which indicated that problems with inadequate configuration management procedures are having an impact on the engineering logistics support capability of HQLC LOGENG Branch.

The research investigation was not exhaustive and only considered those effects identified by the case study and other reports. Accordingly, the results are likely to be conservative. For example, inaccurate and/or incomplete

technical documentation might lead to delays in performing engineering tasks, such as investigating defects, implementing configuration changes, and responding to requests from users for technical assistance. Consequently, the system or technical equipment may be operating contrary to current operational requirements and maintenance personnel might be using inaccurate and/or incomplete technical documentation to carry out field maintenance.

In conclusion, the answers to the investigative questions suggest that current configuration management practices within HQLC LOGENG Branch are having an adverse impact on HQLC LOGENG's ability to provide engineering logistics support to the RAAF.

Researcher's Comments

The researcher's opinion is that configuration management provides a foundation of essential tools necessary to ensure HQLC LOGENG personnel are able to meet their mission of providing logistics support to the RAAF. In the absence of configuration management, HQLC LOGENG personnel have greater risk of operating without focus or necessary technical information, and efforts will be aimed at reactive rather than proactive management. In this environment, the comments that HQLC LOGENG is "fighting bushfires" or engaging in "crisis management" might be justified, and the ability to provide engineering logistics support is severely diminished.

Based on the research results, sections in the aeronautical engineering and telecommunications engineering Directorates seem to be having more difficulty in adopting configuration management procedures and experience the effects of inadequate configuration management procedures to a greater extent. However, this may be due to other factors not considered, such as the complexity or quantity of systems or technical equipments managed. Another factor which may have significant influence is the degree of change activity. TELENG2B, for example, has a high change activity associated with ATC communication systems, with examples reported of individual SYSENGs implementing changes to configuration of the same equipment within a period of weeks. It follows as no surprise that TELENG2B has reported difficulties in maintaining technical documentation for ATC communication systems.

While implementation of configuration management procedures will theoretically provide the foundation of essential management tools, practical implementation may initially be difficult. This will be particularly true for those systems and technical equipments that have been operational for some-time and have inherent or idiosyncratic problems caused by long term neglect of configuration management. Greater success is likely if configuration management procedures are implemented when a system or technical equipment is first introduced into the Service. Moreover, practical implementation of configuration

management may be impeded because of a general lack management information system (MIS) support, unlike the MIS support available to maintenance engineering analysis or spares provisioning.

Although technical personnel may believe they know about configuration management, the researcher believes that details of configuration management can be confounding. The researcher agrees with the many comments that suggested technical staff should be educated in the virtues and benefits of configuration management and believes the RAAF would benefit if configuration management were an inherent part of the culture of operational, technical and support staff.

Recommendations

This research recommends the following:

a. Take action at the earliest opportunity to increase the awareness of configuration management by introducing configuration management as an element of the introductory courses for new arrivals at HQLC and by conducting seminars for existing incumbents.

b. In the medium term, introduce configuration management as a component of all technical trade and engineering officer specialist courses conducted by the RAAF.

c. Establish a configuration management Centre of Expertise within HQLC.

d. Recognize that configuration management is a fundamental management tool that should be integrated into our normal routine. As a consequence, establish a project under the management of the Director of Integrated Logistics Processes (DILP-LC) to investigate and plan for the implementation of configuration management as a comprehensive management system within HQLC.

Recommendation for Further Research

A further recommendation is that a similar survey be carried out approximately 18 months following the issue of new RAAF configuration management policy and procedures and the implementation of WSLM. The research should be conducted in two stages. The first stage would assess any change in the individual's perception of configuration management policy and procedures and the effects on engineering logistics support. The second stage should collect quantitative data to determine the extent to which inadequate configuration management procedures are impacting on HQLC LOGENG's ability to provide logistics engineering support to the RAAF. The purpose of this research would be to guide the DILP-LC project team in assessing those areas of configuration management requiring immediate attention.

Appendix A: Abbreviations and Acronyms

AAP	Australian Air Publication
AEENG1	Aeronautical Engineering - Section 1
AEENG1	Aeronautical Engineering - Section 2
AEENG2	Aeronautical Engineering - Section 2
AEENG3	Aeronautical Engineering - Section 3
AEENG5	Aeronautical Engineering - Section 5
AEENG6	Aeronautical Engineering - Section 6
ADF	Australian Defence Force
ADMIN	Administration
AFB	Air Force Base
AIRENG1	Aircraft Engineering - Section 1
AIRENG2	Aircraft Engineering - Section 2
ATC	Air Traffic Control
AOCLC	Air Officer Commanding Logistics Command
ATE	Automatic Test Equipment
AUP	Avionics Update Programme
AV P	Aviation Publication (UK Ministry of Defence Publication)
CMP(AF)	Configuration Management Plan (Air Force)
DEFAIR	(Australian) Department of Defence (Air Force)
DGELS-LC	Director General Engineering and Logistics, Standards and Systems (Logistics Command)
DI(AF)	Defence Instruction (Air Force)
DI(G)	Defence Instruction (General)

DILP-LC	Director of Integrated Logistics Processes (Logistics Command)
DMO	Draft Modification Order
DoD	US Department of Defense
DTELENG-LC	Director Telecommunications Engineering (Logistics Command)
ECP	Engineering Change Proposal
ENG	Engineering
FCA	Functional Configuration Audit
HES	Hornet Engineering Section
HQLC	Headquarters Logistics Command
IPB	Illustrated Parts Breakdown
LBRIs	Logistics Branch Routine Instructions
LMC	Local Modification Committee
LOGENG	Logistics Engineering
MIL-STD	US Military Standard
MITE	Major Item of Technical Equipment
MRI	Master Record Index
MRRS	Modification Recording and Reporting Section
NAS	Naval Air Station
OPS	Operations
PAT	Process Action Team
PCA	Physical Configuration Audit
QC	Quality Circle
RAAF	Royal Australian Air Force
STI	Special Technical Instruction
SYSENG	System Engineer
TECH	Technical

TELENG2B	Telecommunications Engineering - Section 2B
TELENG2	Telecommunications Engineering - Section 2
TELENG3	Telecommunications Engineering - Section 3
UK	United Kingdom
US	United States
WEAPENG3	Weapons Engineering - Section 3
WEAPENG4	Weapons Engineering - Section 4
WSLM	Weapon System Logistics Management

Appendix B: Definitions

The following definitions have been reproduced from RAAF documents as much as possible. The reader should be aware that in many cases, RAAF definitions for configuration management terms have been adopted from the US DoD system. Where a RAAF document refers to a US DoD document, this latter document is also included as a reference. In some cases, the US DoD document referred to has been superseded. Where this is known to have occurred, the superseding document is given. In other cases, the US DoD might use a (slightly) different definition; these definitions are included where further insight is obtained. Finally, in some cases RAAF documents refer to terms that are not defined. Where relevant, the US DoD definition is provided.

Allocated Baseline. The initially approved documentation describing an item's functional, interoperability, and interface characteristics that are allocated from those of a higher level [configuration item], interface requirements with interfacing configuration items, additional design constraints, and the verification required to demonstrate the achievement of those specified characteristics. (12:6)

Allocated Configuration Identification. The approved allocated baseline plus approved changes. (12:6)

Configuration Audits. Configuration audits are performed in accordance with the Configuration Management Plan to verify compliance with specifications and other contract requirements. The audit function validates accomplishment of development requirements and achievement of a product configuration through examination of technical documentation. Two kinds of audits are performed - functional and physical. (31:A-1)

Configuration Baseline. Configuration documentation formally designated [...] at a specific time during a [Configuration Item's] life cycle. Configuration baselines, plus approved changes from those baselines, constitute the current approved configuration documentation. There are three formally designated baselines in the life cycle of a configuration item, namely the functional, allocated, and product baselines. (12:8)

Configuration Control (or Configuration Change Control). The systematic evaluation, coordination, approval or disapproval of changes, and implementation of all approved changes in the configuration of an item after the initial definition of configuration. (31:A-1; 12:8)

Configuration Identification. The current approved, or conditionally approved, technical documentation for a configuration item as set forth in specifications, drawings and associated lists and documents referenced therein. (31:A-1)

Configuration Item. An aggregation of hardware/software, or any of its discrete portions, which satisfies an end use and is designated for configuration management. (31:A-1; 12:9)

[Configuration Items] may vary widely in complexity, size, and type, from an aircraft, electronic or ship system to a test meter or round of ammunition. During development and initial production, [configuration items] are only those specification items that are referenced directly in a contract (or an equivalent in-house agreement). During the operation and maintenance period, any repairable item designated for separate procurement is a [configuration item]. (29: Chapter 1, Annex A; 11:6)

Configuration Management. A discipline applying technical and administrative direction and surveillance to:

a. identify and document the functional and physical characteristics of a configuration item,

b. control changes to those characteristics, and

c. record and report change processing and implementation status. (31:A-2; 11)

As applied to configuration items, [configuration management is] a discipline applying technical and administrative direction and surveillance over the life cycle of items to:

a. Identify and document the functional and physical characteristics of configuration items.

b. Control changes to configuration items and their related documentation.

c. Record and report information needed to manage configuration items effectively, including the status of proposed changes and implementation status of approved changes.

d. Audit configuration items to verify conformance to specifications, drawings, interface control documents, and other contract requirements. (11:7; 12:9)

Configuration Management Plan. The CMP defines the implementation (including policies and methods) of configuration management on a particular program/project. It may or may not impose contractor requirements depending on whether it is incorporated on the contract. (31:A-2; 10:24)

[A Configuration Management Plan is also the] document defining how configuration management will be implemented (including policies and procedures) for a particular acquisition or program. (12:10)

Configuration Status Accounting. The recording and reporting of the information that is needed to manage configuration effectively, including a listing of approved configuration identification, the status of proposed changes to configuration, and the implementation status of approved changes. (31:A-2)

[Configuration Status Accounting is the] recording and reporting of information needed to manage configuration items effectively, including:

a. A record of approved configuration documentation and identification numbers.

b. The status of approved changes, deviations, and waivers to the configuration.

c. The implementation status of approved changes.

d. The configuration of all units of the configuration item in the operational inventory. (11:7; 12:10)

Design Authority. The Design Authority is the establishment, organization, design approved contractor or firm responsible for the design of the item and which is empowered to sign the Design Certificate. (32:Glossary)

Design Certificate. The Design Certificate is the document which the Design Authority must sign to certify that the technical equipment complies, with the exceptions quoted thereon, with the requirements in the specification. (32:Glossary)

Fit. The ability of an item to physically interface or interconnect with or become an integral part of another item. (12:12)

Form. The shape, size, dimensions, mass, weight, and other visual parameters which uniquely characterize an item. (12:12)

Function. The action or actions which an item is designed to perform. (12:12)

Functional Baseline. The initially approved documentation describing a system's or item's functional, interoperability, and interface characteristics and the verification required to demonstrate the achievement of those specified characteristics. (12:12)

Functional Configuration Audit. The Functional Configuration Audit (FCA) is a formal audit to validate that the development of a configuration item has been completed satisfactorily and that the configuration item has achieved the performance and functional characteristics specified in the functional or allocated configuration identification. In addition, the completed operation and support documents shall be revised. (31:A-1; 15:6)

Functional Configuration Identification. The approved functional baseline plus approved changes. (12:12)

Local Modification Committee (LMC). An LMC is an assembly of RAAF engineers, other RAAF staff, members of other Services, Government Departments, firms, contractors and research organizations brought together to discuss aspects of proposed modification to RAAF technical equipment. The LMC provides a forum for dealing with technical and associated matters related to modifications. The chairman is empowered to accept modifications, subject to formal technical and financial authorization at HQLC. (32:Chapter 19; 37:2)

Major Item of Technical Equipment (MITE). A term introduced for the research to be those major items of technical equipment the survey respondents are currently working with. Examples of MITEs include airborne radar systems, electrical GSE, aircraft engines, fuels and oils, egress systems and airframe structures.

Modification. An approved design change to RAAF technical equipment which:

a. affects the safety, operational use, reliability or other specific design requirement of the equipment;

b. involves significant changes in production or changes which have to be made to equipment already produced or supplied;

c, affects the cost or delivery programme of the equipment or its Service spares; or,

d. affects interchangeability of the equipment or of its Service spares. (32:Chapter 19; 43:1; 37:1

Physical Configuration Audit. The Physical Configuration Audit (PCA) compares the 'as-built' item with its approved and released documentation to assure the documentation is complete. It establishes the product baseline and is appropriate for operational, maintenance and support purposes. (31:A-1)

[A PCA is] a technical examination of a designated configuration item to verify that the configuration item 'As-Built' conforms to the technical document which defines the configuration item. (31:A-1; 15:6)

Product Baseline. The initially approved documentation describing all of the necessary functional and physical characteristics of the configuration item and the selected functional and physical characteristics designated for production acceptance testing and tests necessary for support of the configuration item. In addition to this document, the product baseline of a configuration item may consist of the actual equipment. (12:15)

Product Configuration Identification. The approved product baseline plus approved changes. (12:15)

Type Record. A type record is a document giving a definitive description of the item, design assumptions, strength calculations including reference to material data sheets, strength factors, aerodynamic a static loads, environmental conditions, qualification tests and results, a list of approved manufacturing drawings, procedure and process sheets (Master Record Index Number), weight data, design performance and handling limitations and a list of subsidiary type records or equivalent approvals in respect of equipments manufactured by sub-contractors. The Design Certificate is attached to, and forms part of the type record. In some cases, the Design Certificate, with

relevant supporting data, is acceptable as a type record. (32: Glossary)

Appendix C: Survey Cover Letter

This appendix includes a copy of the covering letter used for the survey.

HQLC ENGINEERING SUB-BRANCH

CONFIGURATION MANAGEMENT SURVEY

APPOINTMENT:_____

INTRODUCTION

Certain sub-sections within DGELS-LC have reported concerns that inadequate configuration management (CM) has adversely affected their ability to provide quality engineering logistics support. Although some preliminary investigations have been conducted, these investigations have been confined mainly to the sub-sections. While the problems may be unique to these sub-sections, the actual extent of the problem within HQLC is not known.

Although this survey has the support of DGELS-LC, it is being conducted independently by FLTLT John Turner. FLTLT Turner is currently undertaking a Master of Science Degree in Logistics at the United States Air Force Institute of Technology. The survey, which was prompted by FLTLT Turner's experiences as a Systems Engineer in TELENG over the period January 1985 to April 1991, has the following aims:

a. to seek the professional opinions of DGELS-LC personnel to determine the current status of CM within HQLC, and

b. to assess the impact on engineering logistics support capabilities.

The responses may then be used to help those sub-sections experiencing problems by identifying potential corrective action. Therefore, your response will prove vital in helping these sub-branches better perform their duties.

CONFIDENTIALITY

Completed survey responses will be confidential. However, it is essential to effective analysis that a CM profile be established by sub-section. Sub-sections where CM procedures are not causing concerns may be used as a model for other sub-sections. Accordingly, each survey will include a control number which will be used by the researcher to identify the respondent by sub-section. When

the survey data has been collected, reference to individual respondents will be destroyed. Data will be used to support trend analysis and replies will not be directly attributed to respondents.

INSTRUCTIONS

Please complete the attached survey as soon as possible. The survey will take about 15-30 minutes to complete. **You should not refer to other documentation (eg: files, Defence Instructions, or LBRIs), but give the appropriate response to the best of your current knowledge.**

CM involves many interrelated facets. Therefore, don't be concerned if you do not know the answer to any given question(s) or if the questions seem not to be applicable to your duties. **This survey is not intended to be a test of your individual knowledge,** but will facilitate analysis which will seek to establish trends in what is known as well as what is not known. Remember, it is important for accurate analysis that you answer the questions as honestly as you can.

This cover sheet need not be returned with completed surveys.

ANY QUESTIONS?

Questions regarding any aspect of the questionnaire are welcome and can be directed to the survey liaison officer, namely WOFF Garry Turner (AEENG1B3A, Ext 23126).

RETURNING THE SURVEY

The survey is to be completed as soon as possible and returned **no later than close of business (15 July 1992)** to WOFF Garry Turner (AEENG1B3A Ext 23126 DRVT-T-3).

Appendix D: Pretest Configuration Management Survey

This appendix includes the first draft of the configuration management survey which was used as the pretest.

SECTION 1: BACKGROUND

1. Personal Details (optional)

   a. Name:_____

   b. Appointment:_____

2. Experience

   a. Please circle as applicable: officer/enlisted/civilian

   b. Period of service:

      (1) Current appointment: _____years_____months

      (2) Total HQLC service: _____years_____months

      (3) Total Defence service: _____years_____months

3. My duties involve either management or actual participation in one or more of the following (check all that apply):

- ☐ Investigation and/or rectification of defects
- ☐ Modifications (management, design, mod orders, etc)
- ☐ Evaluation of Mod proposals from any source
- ☐ Preparation of Specifications for any purpose
- ☐ Publications (sponsor, issue, amendment, disposal)
- ☐ Procurement (either new or existing equipment)
- ☐ Projects to introduce new capabilities (ie not mods)
- ☐ "Running System" Support (of in-service equipment)
- ☐ Advice on maintenance policy decisions (eg TMP)
- ☐ Advice on component identification (eg DI(AF) SUP 9/15)

4. Briefly describe your duties:

_____

_____

5. Please list the major items of parent equipment that you are associated with (eg: C130, Hornet, fire trucks, ATE):

   a. _____ c. _____

   b. _____ d. _____

6. Please list the major items of technical equipment that you are associated with (eg: ATC communications, airborne radar, airframe structures, fuels and oils, electrical GSE, ATE)

   a. _____ c. _____

   b. _____ d. _____

7. Of the items listed at Question 6, please state the one that consumes most of your effort:

   a. _____

8. Please state your primary area of responsibility (eg: design and preparation of mods, publication amendments):

   a. _____

SECTION 2:

9.

Instructions:

Unless otherwise stated, ALL questions in SECTION 2 refer to that item of technical equipment listed at Question 7. For convenience, this item will be referred to as the MITE. The MITE may be a system itself, such as a ground radar system. Alternatively, the MITE may be a smaller item which is part of another system, such as an aircraft engine or a class of GSE, such as electrical GSE.

Please use the following scale and indicate your response by placing an "X" in the appropriate column. If you do not know the answer to a question, or if you not sure about your response, then you should place an "X" in the column marked "C".

O	A	B	C	D	E
Not Applicable	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree

	O	A	B	C	D	E
I understand the principles of CM						
I can identify the elements of CM						
I know where RAAF CM policy is written						
I know where RAAF CM procedures are written						
The principles of CM are not relevant to the MITE						
The principles of CM are applied to the MITE						
A CM specialist has been appointed for the MITE						
My responsibilities regarding CM are well defined						
Configurations Items have been identified						

	O	A	B	C	D	E
The MITE requires on-going logistics support (eg: spare part provisioning, maintenance)						
The RAAF may require to introduce more of the MITE into the RAAF inventory						
A full set of technical documentation (eg specifications, operating and maintenance procedures, spare parts list etc) exists						
A formal configuration baseline has been established						
A list of all relevant technical documents (eg a Master Record Index) exists						
A Type Record has been issued for the MITE						
A Design Certificate has been issued for the individual items of MITE						
Form, Fit, and Functional characteristics are documented						
Production acceptance tests have been documented						
Configuration Identification has been established for the Product Baseline						
Interface documentation exists to establish the degree of integration and compatibility among Configuration Items						
A formal system is used to propose changes to the MITE						
A formal system is used to evaluate proposed changes to the MITE						
A formal system is used to approve changes						
A formal system is used to ensure approved configuration changes are incorporated on schedule						

	O	A	B	C	D	E
Records are maintained which report the configuration status of the MITE at all times during its life cycle						
Sufficient documentation exists to ensure necessary logistics support activities (eg identification of spares, maintenance procedures) can be carried out during the life cycle						
I have effected changes to the MITE which has required amendment of associated documentation						
The technical documentation accurately reflects the configuration of the MITE						

SECTION 3:

Instructions:

Please answer the following questions. You are invited to provide any comments that might help the researchers.

10. RAAF CM policy is stated in the following document(s):

_____Not Known

_____

_____

_____

Comments:_____

_____

_____

11. RAAF CM procedures can be found in the following document(s):

_____Not Known

_____

_____

_____

Comments:_____

_____

_____

SECTION 4:

Instructions:

Please answer the following questions by circling the appropriate response(s). You are invited to provide any comments that might help the researchers. As with SECTION 2, questions in this section relate to that item of technical equipment listed at Question 6, except where stated otherwise.

12. A CMP-AF has existed for the MITE for the period (please circle as appropriate):

    a. there is no CMP-AF
    b. not known
    c. since the item was introduced into service
    d. less than 6 months
    e. 7-12 months
    f. 13-24 months
    g. greater than 24 months

    Comment:_____

    _____

    _____

13. Publication amendments to reflect configuration changes are issued (to the field) as follows:

    a. When the configuration changes are implemented
    b. Within 6 months of implementing the configuration changes
    c. 7-12 months after the configuration changes have been implemented
    d. 13-24 months after the configuration changes have been implemented
    e. Greater than 24 months after the configuration changes have been implemented.

    Comment:_____

    _____

    _____

14. Has a comparison between the "as-is" MITE and the design documentation been carried out?

a. Yes
b. No
c. Don't Know

Comment:_____

_____

_____

15. For some MITEs, changes in configuration during production resulted in differences between individual MITEs. For your MITE, are such changes documented?

a. No such changes are known to have occurred
b. Yes
c. No
d. Unknown

Comment:_____

_____

_____

16. For some MITEs, there is more than one configuration status of fielded units, which has the following effect(s) (check all that apply):

    a. Instructions to implement configuration changes (eg: mod orders, GTIOs) are not applicable to all fields units.

    b. Technical documentation does not correctly describe all fielded units.

    c. Investigations (eg: defect investigation, mod design, user queries) are delayed.

    d. Maintenance policies may not be applicable to all fielded units.

    e. As-is configuration of fielded units is not known.

    f. Difficulties in evaluating modification proposals or other proposals affecting operation and/or maintenance.

17. For some MITEs, the technical documentation is inaccurate and/or incomplete, which has the following effect(s) (check all that apply):

    a. Difficulties in evaluating modification proposals or other proposals affecting operation and/or maintenance.

    b. As-is configuration of fielded units is not known.

    c. Investigations (eg: defect investigation, mod design, user queries) are delayed.

    d. Maintenance policies may not be applicable to all fielded units.

    e. Decisions regarding maintenance policies may be based on inaccurate data.

    f. Designs for modifications or other changes to configuration status may be incorrect, thus requiring rework and possible delays to task completion.

    g. Field maintenance personnel may be using inaccurate and/or incomplete technical documentation to carry out maintenance activities.

SECTION 5

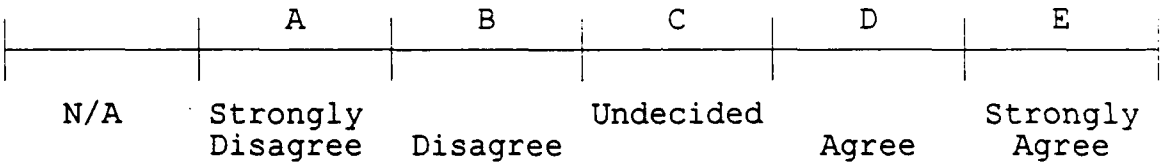
18.

Instructions

Unless otherwise stated, ALL questions in SECTION 5 refer to that item of technical equipment listed at Question 7.

Please use the following scale and indicate your response by placing an "X" in the appropriate column. If you do not know the answer to a question, or if you not sure about your response, then you should place an "X" in the column marked "C".

Note also that some responses also require You are invited to provide comments in the space provided.



	O	A	B	C	D	E
Delays are experienced in processing publication amendments Comment:						
Data for this MITE is incomplete Comment:						

	O	A	B	C	D	E
Some sections are experiencing high manpower turnover rates with staff remaining in the section for only 18 months to two years. Using this as a benchmark, our section is also experiencing high manpower turnover rates. Comment:						
The staff in our section can be described as inexperienced, either in terms of the MITE, or in terms of HQLC experience. Comment:						
Following the implementation of a change in MITE configuration, it is possible that not all relevant publications are amended . Comments:						

Appendix E: Configuration Management Survey

This appendix includes the final version of the HQLC Engineering Branch Configuration Management Survey.

SECTION 1: BACKGROUND

1. Personal Details (optional)

   a. Name:_____

   b. Appointment:_____

2. Experience

   a. Please circle as applicable: officer/enlisted/civilian

   b. Period of service:

      (1) Current appointment: _____years_____months

      (2) Total HQLC service: _____years_____months

      (3) Total Defence service: _____years_____months

3. My duties involve either management or actual participation in one or more of the following (check all that apply):

- ☐ Investigation and/or rectification of defects
- ☐ Modifications (management, design, mod orders, etc)
- ☐ Evaluation of Mod proposals from any source
- ☐ Preparation of Specifications for any purpose
- ☐ Publications (sponsor, issue, amendment, disposal)
- ☐ Procurement (either new or existing equipment)
- ☐ Projects to introduce new capabilities (ie not mods)
- ☐ "Running System" Support (of in-service equipment)
- ☐ Advice on maintenance policy decisions (eg TMP)
- ☐ Advice on component identification (eg DI(AF) SUP 9/15)
- ☐ Liaison with Field Service Representatives or equivalent
- ☐ Other (please specify)

4. Briefly describe your duties:

_____

_____

5. Please list the major items of parent equipment that you are currently associated with (eg: C130, Hornet, electrical GSE, fire trucks, ATE):

a. _____ c. _____

b. _____ d. _____

6. Please list the Major Items of Technical Equipment (MITE) that you are currently associated with (eg: ATC communications, airborne radar, airframe structures, fuels and oils, electrical GSE, ATE):

a. _____ c. _____

b. _____ d. _____

7. Of the item(s) listed at Question 6, please state the one that you spend most time on:

a. _____

8. Please state your primary area of responsibility (eg: design and preparation of mods, publication amendments):

a. _____

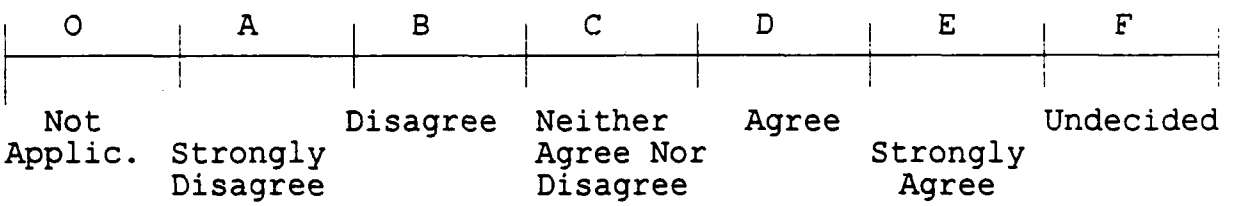
SECTION 2:

9.

Instructions:

Unless otherwise stated, questions in SECTION 2 refer to the MITE identified at Question 7. The MITE may be a system itself, such as a ground radar system. Alternatively, the MITE may be a smaller item which is part of another system, such as an aircraft engine or a class of GSE, such as electrical GSE.

Please use the following scale and indicate your response by placing an "X" in the appropriate column. For example, if you can not decide the answer to a question, place an "X" in the column marked "F".



	O	A	B	C	D	E	F
I understand the principles of CM							
I can identify the elements of CM							
I know where RAAF CM policy is promulgated							
I know where RAAF CM procedures are promulgated							
The principles of CM are not relevant to my MITE							
The principles of CM are applied to my MITE							
A CM specialist has been appointed for my MITE							
My responsibilities regarding CM are well defined							

	O	A	B	C	D	E	F
Configuration Items have been identified for my MITE							
My MITE requires on-going logistics support (eg: spare part provisioning, maintenance)							
The RAAF may require to introduce more of my MITE into the RAAF, Army, and/or Navy inventories							
I have access to a full set of technical documentation (eg specifications, operating and maintenance procedures, spare parts list etc)							
A formal configuration baseline has been established for my MITE							
A list of all relevant technical documents (eg a Master Record Index) exists							
A Type Record has been issued for my MITE							
A Design Certificate has been issued for the individual items of MITE							
I have access to documentation that describes Form, Fit, and Functional characteristics							
I have access to documentation that describes Production acceptance tests							
Configuration Identification has been established for the Product Baseline of my MITE							
I have access to interface documentation that exists to establish the degree of integration and compatibility among Configuration Items							

	O	A	B	C	D	E	F
A formal system is in place to propose changes to my MITE							
A formal system is in place to evaluate proposed changes to my MITE							
A formal system is in place to approve changes to my MITE							
A formal system is in place to ensure approved configuration changes are incorporated on schedule							
Historical records are maintained which report the configuration status of my MITE at all times during its life cycle							
Sufficient documentation exists to ensure necessary logistics support activities (eg identification of spares, maintenance procedures) can be carried out during the life cycle of my MITE							
I have made changes to my MITE which have required amendment of documentation							
The technical documentation accurately reflects the configuration of the MITE							

SECTION 3:

Instructions:

Please answer the following questions. You should not refer to other documentation (eg: files, Defence Instructions, or LBRIs), but give the appropriate response to the best of your current knowledge. You are invited to provide any comments that might help the researcher.

10. RAAF CM policy is stated in the following document(s) (place an "*" against those you have read within the most recent six months):

_____Not Known

_____

_____

_____

*Comments:*_____

_____

_____

11. RAAF CM procedures can be found in the following document(s) (place an "*" against those you have read within the most recent six months):

_____Not Known

_____

_____

Comments:_____

_____

_____

12. Are the policy and procedural instructions useful to you?

Policy:	Procedures:
_____Yes	_____Yes
_____No	_____No

Comments:_____

_____

_____

13. Are the policy and procedural instructions easy to read?

Policy:	Procedures:
_____Yes	_____Yes
_____No	_____No

Comments:_____

_____

_____

14. Please give any additional comments you think might assist the research:

Comments:_____

_____

_____

SECTION 4:

Instructions:

Please answer the following questions by circling the appropriate response. You are invited to provide any comments that might help the researcher. Questions in SECTION 4 relate to the MITE identified at Question 7.

15. An in-service CMP-AF has existed for my MITE for the following period:

a. there is no CMP-AF
b. not known
c. less than 6 months
d. 7-12 months
e. 13-24 months
f. greater than 24 months

Comment:_____

_____

_____

16. Has the in-service CMP-AF existed since the MITE was introduced into service?

_____Yes

_____No

_____Don't Know

17. Publication amendments to reflect configuration changes are issued from SOPUBS as follows:

    a. Don't know
    b. Prior to the configuration Change being implemented
    c. When the configuration changes are implemented
    d. Within 6 months of implementing the configuration changes
    e. 7-12 months after the configuration changes have been implemented
    f. 13-24 months after the configuration changes have been implemented
    g. Greater than 24 months after the configuration changes have been implemented.

    Comment:_____

    _____

    _____

18. Has a comparison between the "as-is" MITE and the design documentation been carried out within the past two years?

    a. Yes
    b. No
    c. Don't Know

    Comment:_____

    _____

    _____

19. For some MITEs, changes in configuration during production has resulted in differences between individual MITEs. For your MITE, are such production changes documented?

a. No such changes are known to have occurred
b. Yes
c. No
d. Unknown

Comment:_____

_____

20. For some MITEs, there is more than one configuration status of fielded units, and this has caused some problems for Systems Engineers. Of the following possible problems, please circle all responses that either have been or are currently applicable to your MITE.

a. Instructions to implement configuration changes (eg: mod orders, GTIOs) are not applicable to all field units.

b. Technical documentation does not correctly describe all fielded units.

c. Investigations (eg: defect investigation, mod design, user queries) are delayed.

d. Maintenance policies may not be applicable to all fielded units.

e. "As-is" configuration of fielded units is not known.

f. Difficulties in evaluating modification proposals or other proposals affecting operation and/or maintenance.

g. No known adverse affects.

21. For some MITEs, the technical documentation is inaccurate and/or incomplete. Of the following possible problems, please circle all responses that have been or are applicable to your MITE.

    a. Difficulties exist in evaluating modification proposals or other proposals affecting operation and/or maintenance.

    b. "As-is" configuration of fielded units is not known.

    c. Investigations (eg: defect investigation, mod design, user queries) are delayed.

    d. Maintenance policies may not be applicable to all fielded units.

    e. Decisions regarding maintenance policies may be based on inaccurate data.

    f. Designs for modifications or other changes to configuration status may be incorrect, thus requiring rework and possible delays to task completion.

    g. Field maintenance personnel may be using inaccurate and/or incomplete technical documentation to carry out maintenance activities.

    h. Unable to judge the airworthiness of a given MITE.

    i. No known effects.

22. Please complete the following sentence: "I know CM is important to my MITE, but ..."

_____

_____

_____

_____

_____

23. Inadequate configuration management of certain MITEs has adversely affected the ability of some HQLC Engineering Sub-branch personnel from providing adequate logistics engineering support. Please indicate if inadequate CM has caused you any problems and illustrate by giving short examples:

_____Yes

_____No

_____

_____

_____

_____

_____

_____

_____

24. Please indicate where CM must be improved so that you can better perform your duties:

_____

_____

_____

_____

_____

_____

_____

SECTION 5

25.

Instructions

Unless otherwise stated, questions in SECTION 5 refer to the MITE identified at Question 7.

Please use the following scale and indicate your response by placing an "X" in the appropriate column. For example, if you can not decide the answer to a question, place an "X" in the column marked "F".

O	A	B	C	D	E	F
Not Applic.	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree	Undecided

	O	A	B	C	D	E	F
Delays are experienced in processing publication amendments Comment:							
Data for this MITE is incomplete Comment:							

	O	A	B	C	D	E	F
Some sections are experiencing high manpower turnover rates with staff remaining in the section for only 18 months to two years. My section also experiences high manpower turnover rates. How long do staff remain within the sub-section: a. 0-12 months b. 13-24 months c. 25-36 months d. >36 months. Comment:							
The staff in our section can be described as inexperienced because they normally have had no previous experience on the MITE. Comment:							
The staff in our section can be described as inexperienced because they normally have had no previous experience in HQLC. Comment:							
Following the implementation of a change in my MITE's configuration, not all relevant publications are amended. Comment:							

END OF SURVEY - THANK YOU FOR YOUR SUPPORT

Appendix F: Configuration Management Survey - Aggregate Results

This appendix presents a summary of the raw survey data, taken from a HQLC LOGENG perspective. The original data was collected from individuals identified by a unique control code. Although the control enabled data analysis on a section by section basis, the results are shown in aggregate form (that is, from a HQLC LOGENG perspective).

Not all survey question responses are reported. In particular, demographic responses and comments are excluded. Similarly, comment responses are also excluded. Selected comments are discussed in Chapter IV and are presented as Appendix G.

SECTION 2

9. The table records the total number of responses for the indicated option. The maximum number of responses is 72. However, because not all respondents answered each question, it is possible for a given row to add to less than 72.

	O	A	B	C	D	E	F
I understand the principles of CM		1	2	3	46	20	
I can identify the elements of CM		2	7	12	38	10	3
I know where RAAF CM policy is promulgated		3	15	4	33	8	7
I know where RAAF CM procedures are promulgated		1	14	6	31	10	7
The principles of CM are not relevant to my MITE		42	19	6	2	1	2
The principles of CM are applied to my MITE		2	8	7	37	14	4
A CM specialist has been appointed for my MITE		15	14	8	17	3	14
My responsibilities regarding CM are well defined	1	8	14	15	21	4	9
Configuration Items have been identified for my MITE		8	10	6	30	12	6
My MITE requires on-going logistics support (eg: spare part provisioning, maintenance)		1		1	24	45	1
The RAAF may require to introduce more of my MITE into the RAAF, Army, and/or Navy inventories	3	4	10	12	26	9	8
I have access to a full set of technical documentation (eg specifications, operating and maintenance procedures, spare parts list etc)		7	8	4	42	10	1

	O	A	B	C	D	E	F
A formal configuration baseline has been established for my MITE		8	19	14	15	7	9
A list of all relevant technical documents (eg a Master Record Index) exists		7	18	9	22	7	8
A Type Record has been issued for my MITE	1	11	19	10	7	2	20
A Design Certificate has been issued for the individual items of MITE		9	11	15	8	4	24
I have access to documentation that describes Form, Fit, and Functional characteristics		1	7	8	43	5	7
I have access to documentation that describes Production acceptance tests		7	11	10	28	3	12
Configuration Identification has been established for the Product Baseline of my MITE		3	17	14	18	5	14
I have access to interface documentation that exists to establish the degree of integration and compatibility among Configuration Items	3	7	13	18	16	2	12
A formal system is in place to propose changes to my MITE		3	8	9	35	14	3
A formal system is in place to approve changes to my MITE		4	8	9	36	11	4
A formal system is in place to ensure approved configuration changes are incorporated on schedule		9	16	17	20	2	8
Historical records are maintained which report the configuration status of my MITE at all times during its life cycle		4	21	9	26	7	5

	O	A	B	C	D	E	F
Sufficient documentation exists to ensure necessary logistics support activities (eg identification of spares, maintenance procedures) can be carried out during the life cycle of my MITE		2	7	11	43	7	2
I have made changes to my MITE which have required amendment of documentation			2	5	38	26	1
The technical documentation accurately reflects the configuration of the MITE		6	15	18	29	1	3

SECTION 3:

10. The assessment of knowledge of RAAF configuration management policy was based on the ability of a member to record one of the recognized policy documents as follows:

a. DI(AF) OPS 2-7 Joint ADF configuration management policy

b. DI(AF) OPS 2-1 RAAF configuration managemtn policy for systems

c. DI(AF) OPS 2-2 RAAF configuration management for software

d. DI(AF)TECH 4-8 RAAF configuration management for technical equipment

e. DI(AF) ENG 2-4 Draft configuration management policy to replace DI(AF) TECH 4-8.

Results: Based on survey responses, 12 have knowledge; 60 do not.

Observation: Of the 60 assessed as not knowing where configuration management policy is promulgated, many recorded procedural documents [such as DI(AF) 7001.025, or a particular equipment CMP(AF)] in lieu of policy.

11. The assessment of the knowledge of RAAF configuration management procedure was based on the ability of respondent to record one of the recognized procedural documents as follows:

a. DI(AF) AAP 7001.025 RAAF configuration management procedures

b. DI(AF) AAP 7001.040 RAAF software configuration mangement procedures

c. CMP(AF) Dedicated configuration management procedures for a system or technical equipment

d. DI(AF) AAP 7001.047 Draft configuration management procedures to replace DI(AF) AAP 7001.025

Results: Based on survey responses, 32 have knowledge; 40 do not.

Observation: Of the 40 assessed as not knowing where configuration management procedures are promulgated, many referred to LBRIs. Although LBRIs contain some configuration management procedures, these are confined to a limited view of configuration control, and also to procedures for management of modifications. Accordingly, reference to LBRIs was rejected as indication of knowledge.

12. Usefulness of policy and procedures:

a.	Policy is useful:	31 YES 18 NO 23 NO RESPONSE
b.	Procedures are useful:	35 YES 14 NO 23 NO RESPONSE

13. Ease of reading

a.	Policy easy to read:	23 YES 24 NO 25 NO RESPONSE
b.	Procedures easy to read:	24 YES 24 NO 24 NO RESPONSE

Observation: Comments associated with Questions 12 & 13 indicate that respondents were thinking about the draft RAAF configuration management procedures to be issued as DI(AF) AAP 7001.047 (r16). However, the questions were intended to refer to policy and procedures listed above (refer to Questions 11 & 12)

SECTION 4:

15. An in-service CMP-AF has existed for my MITE for the following period:

23	a.	there is no CMP-AF
27	b.	not known
7	c.	less than 6 months
1	d.	7-12 months
11	e.	13-24 months
3	f.	greater than 24 month

16. Has the in-service CMP-AF existed since the MITE was introduced into service?

4	Yes
39	No
27	Don't Know
2	Nil response

17. Publication amendments to reflect configuration changes are issued from SOPUBS as follows:

16	a.	Don't know
5	b.	Prior to the configuration Change being implemented
6	c.	When the configuration changes are implemented
17	d.	Within 6 months of implementing the configuration changes
12	e.	7-12 months after the configuration changes have been implemented
8	f.	13-24 months after the configuration changes have been implemented
6	g.	Greater than 24 months after the configuration changes have been implemented.

18 Has a comparison between the "as-is" MITE and the design documentation been carried out within the past two years?

21	Yes
27	No
24	Don't Know

19. For some MITEs, changes in configuration during production has resulted in differences between individual MITEs. For your MITE, are such production changes documented?

5	No such changes are known to have occurred
40	Yes
5	No
22	Unknown

20. For some MITEs, there is more than one configuration status of fielded units, and this has caused some problems for Systems Engineers. Of the following possible problems, please circle all responses that either have been or are currently applicable to your MITE.

32	a.	Instructions to implement configuration changes (eg: mod orders, GTIOs) are not applicable to all fields units.
27	b.	Technical documentation does not correctly describe all fielded units.
33	c.	Investigations (eg: defect investigation, mod design, user queries) are delayed.
18	d.	Maintenance policies may not be applicable to all fielded units.
21	e.	As-is configuration of fielded units is not known.
27	f.	Difficulties in evaluating modification proposals or other proposals affecting operation and/or maintenance.
12	g.	No known adverse affects.

21. For some MITEs, the technical documentation is inaccurate and/or incomplete. Of the following possible problems, please circle all responses that have been or are applicable to your MITE.

23	a.	Difficulties exist in evaluating modification proposals or other proposals affecting operation and/or maintenance.
23	b.	As-is configuration of fielded units is not known.
26	c.	Investigations (eg: defect investigation, mod design, user queries) are delayed.
15	d.	Maintenance policies may not be applicable to all fielded units.
24	e.	Decisions regarding maintenance policies may be based on inaccurate data.
25	f.	Designs for modifications or other changes to configuration status may be incorrect, thus requiring rework and possible delays to task completion.
40	g.	Field maintenance personnel may be using inaccurate and/or incomplete technical documentation to carry out maintenance activities.
4	h.	Unable to judge the airworthiness of a given MITE.
16	i.	No known effects.

23. Inadequate configuration management of certain MITEs has adversely affected the ability of some HQLC Engineering Sub-branch personnel from providing adequate logistics engineering support. Please indicate if inadequate CM has caused you any problems and illustrate by giving short examples:

36	Yes
26	No
10	No response

SECTION 5

	O	A	B	C	D	E	F
Delays are experienced in processing publication amendments	1		6	11	21	26	4
Data for this MITE is incomplete		2	15	15	19	10	7
Some sections are experiencing high manpower turnover rates with staff remaining in the section for only 18 months to two years. My section also experiences high manpower turnover rates. How long do staff remain within the sub-section: 4 a. 0-12 months 28 b. 13-24 months 15 c. 25-36 months 8 d. >36 months.		2	14	8	16	12	3
The staff in our section can be described as inexperienced because they normally have had no previous experience on the MITE.		10	21	13	12	14	
The staff in our section can be described as inexperienced because they normally have had no previous experience in HQLC.			14	22	26	8	
Following the implementation of a change in my MITE's configuration, not all relevant publications are amended.		4	25	13	19	5	4

Appendix G: Survey Comments

The following comments were taken directly from the survey responses. Comments that might can be traced to a respondent have been excluded or reworded to preserve survey confidentiality.

Question 12 Comments

They are useful, but they often require time for interpretation.

Remove ambiguities between DI(AF) AAP 7001.025 & DI(AF) AAP 7001.047 and provide more details on in-service implementation.

They conflict with current requirements for aircraft CMPs (in some areas only).

Although useful, they limited due to fragmented implementation. Also, they are out of date and out of touch with changing and evolving weapon system in-service support environment and associated requirements.

The policy and procedural instructions for RAAF configuration management are not useful because they are spread over many publications. Policy and procedural instructions would be useful if promulgated in one publication only.

Policy doesn't specifically address what to do with ground telecommunication equipment where some of the effort of configuration management is not worthwhile.

Question 13 Comments

The instructions are often complex because of the complexity of the subject and the need for detail.

I found the instructions to be both ambiguous and vague (in some areas).

Easy to read as individual documents, but not as a reference collection.

Unless you have a sound understanding of configuration management initially, procedures are difficult to digest and even more difficult to apply.

Use of officialese, verbosity, and vague language is the worst part of DI(AF) ENG 2-4.

Question 14 Comments

Lack of configuration management in the past has lead to poor current aircraft configuration states.

With the current job profile and the support given to my MITE, we are too busy fighting bushfires. My MITE has been treated badly for so long and as a necessary piece of equipment only, it has been degraded badly. Little control and little support.

In the short time frame that people were given to prepare CMPs, an adequate job was performed. Continued work will be required to simplify and streamline procedures to enable all levels of staff to fully comprehend.

It is time to develop a 'vision' and supporting plan to move CM into the fully electronic support environment and out of the current 'dark ages' approach. Policy and resources (especially) need to be put in place to drive this development. However, a comprehensive and well detailed statement or requirement needs to be assembled, and a demo application would go a long way to help convince senior management that the time is now to 'bite the bullet' and make an investment for the future.

Training of members posted to HQLC would increase awareness of what and how we do the jobs we are assigned to.

Procedures require updating and rigid enforcement of use.

Unless aircraft CMPs are held in check by an over-riding RAAF weapon system CMP, then commonality and compatibility between weapon systems will, in the long term, suffer degradation.

All the different publications that refer to configuration management in one shape or form, do at times have different policy/procedures. Suggest that one comprehensive document be used.

The DI(AF) AAP 7001.047 must be rewritten in simple, easy to understand language, and aimed specifically at in-service systems, and also at ALL managers.

We need an instruction to give guidance in adopting configuration management procedures, and how to transition from existing records and process to the desired end result.

Policy and procedures are fine, but the need to establish baseline configuration is essential, and finding the time and details for equipment already installed is almost impossible. Application of policy to new equipment being introduced appears to be the way to go.

Question 19 Comment

Part numbers seem to be different from original fit. The OEM upgraded and superseded parts willy nilly.

Question 22

I know configuration management is important to my MITE, but...

...it has not been carried out for 22 years and so lots of work needs to be done.

...for reasons of ease, efficiency, or simplicity, the configuration management policies and procedures are not always followed to the letter, or are "re-interpreted" depending on the circumstances.

...manufacturing contractor components sometimes differ from OEM specs - (confusion rules).

...configuration management is a time-consuming business which has taken a back seat to dealing with urgent airworthiness issues to keep aircraft flying (that is crisis management).

...because most of my work deals with Army Aviation, I have trouble communicating; Army and RAAF systems not compatible

...units still operate equipment without the correct authorizations.

...everyone else at the units need to be aware of its importance as well.

...no guidelines or goals have been issued.

...I have insufficient manpower and IT resources available to be able to carry configuration management to the level of quality and effectiveness that I consider is required.

...very little emphasis has been given to educating all in Command of configuration management policy and instructions.

...SYSENGs are often in a position authorizing configuration changes, but with little or no previous experience. Publication amendments are very slow to be promulgated.

...configuration management cannot be effectively managed without a centralized configuration database.

...but unfortunately, configuration management was not clearly specified or followed during the early period of the F111C simulator's life. This has caused numerous configuration problems and resulted in variations to aircraft characteristics.

...too many people involved, each with their own interpretations, which is causing confusion, indecision, and delays.

...poor control and awareness of configuration management leads to a "she'll be right" attitude.

...no mention of configuration management was made on the courses I attended when first arriving at HQLC.

...with new equipments purchased, it is not always possible or desirable to keep all configuration items the same, thus making configuration management difficult.

...I do not have an accurate set of guidelines to govern configuration management of my MITE which has not had configuration management principles applied to it since its inception into Service.

...I don't know anything about configuration management, despite being responsible for modification tasks.

...the best time manager in the world could not effectively manage all the equipments I currently am supposed to.

...it is difficult to keep up with the changes.

...due to lack of time (manpower), only priority (crisis) tasks can be completed.

...the manpower required to correct the database and obtain all data from the manufacturers is beyond manpower capability.

...configuration management has had neither funding nor priority allocated to it.

...the time required to follow configuration management is and inducement to take shortcuts which will eventually cause long term problems.

...we lack accurate configuration baseline data to establish a configuration management document

...the beginning is a good place to start.

...the task of establishing baselines for all existing equipments is beyond current manning capability.

Question 23 Examples

HS748 aircraft fleet is in poor state due to total lack of good configuration management within HQLC.

When an OEM service bulletin arrives for evaluation about a certain part number, it is sometimes difficult to establish if it is applicable to RAAF MITEs.

The F111 airframe has been well documented and recorded.

Officers not trade related control this area and only for a period of approximately 18 months before posting.

Because of the age of the MITE, traceability of relevant data for the configuration change is extremely difficult and sometimes impossible.

On occasions, the OEM have incorrectly identified reworked/modified components in their technical documentation (eg: ECPs). As a result, delays are experienced by staff attempting to compile modification orders from poorly written technical data.

The Hornet aircraft experienced numerous production wiring changes on circuit breakers and relay panel assemblies. This resulted in many different part numbers applicable to only a small number of aircraft.

Modifications are being incorporated (by OEMs) on items returned for repair/overhaul - these modifications were not known about by the SYSENG.

Exact status of cockpit configuration is difficult to determine.

RAAF modifications have not been notified to OEM, thus not allowing OEM to update wiring manuals and technical publications (for example: maintenance manuals).

More awareness of configuration management is required.

The configuration management system should be "user-friendly" and flexible.

Insufficient coherent and simple guidelines are available to allow me to practice good configuration management.

The most common problem is that not all of the relevant publications are amended when equipment is modified.

With the trend to work smarter, someone may allow the rules to become more applicable to the equipment type. For example, aircraft forms and orders are not always appropriate for some equipment types.

Changes made in production have resulted in many items fitted to my MITE having revision levels which vary from one fielded unit to another. The publications for maintenance of these items do not apply to all revision levels held by RAAF.

Question 24 Comments

Processes need to be put in place in HQLC to ensure configuration management is properly enforced and that regular surveillance carried out.

Documentation is poor and a better explanation of configuration management procedures is required.

Configuration management is improving because it is being made aware to systems managers and user units.

A database showing configuration of all configuration items, including repairs, is required. This would allow better determination of interaction between repairs and other configuration variations.

Officers' postings are too short and there is no Branch applicable to my trade.

Configuration management needs to be simplified to enable the inexperienced person to understand the basics.

Need to provide a licensed engineer for my MITE.

Configuration management needs to be better packaged and accurate during capital project acquisition and transitioned to in-service support as a working and effective application.

Currently, several databases exist in the RAAF (RAAFSUP, CAMM, COMPLAN, ...). The key linking thread is configuration control. Unfortunately, to supply person, NSN is everything, but with respect to configuration control, part number and MRN are everything while NSN guarantees very little.

Better training on configuration management within HQLC LOGENG for airmen is required.

Allow SYSENGs to authorize configuration changes; the current situation where only the OEM may approve changes is impairing effectiveness to provide timely support for my MITE.

Need to coordinate the creation of CMP databases. That is, don't have each section designing and implementing different databases.

SYSENGs have the ability to adequately perform configuration management if the system is controlled/designed and special training is given for each weapon system.

Better education of policy and configuration management instructions for all engineering/maintenance and technical support musterings is required.

Better feedback to the manufacturer's configuration data base is required. At the moment, some part numbers fitted to aircraft are not recognized by that manufacturer's database.

Streamline policy and procedures.

Need to promote a configuration management culture to new SYSENGs.

The interface between engineering, supply, and repair and overhaul must be enforced to ensure configuration management principles are applied at all levels of configuration item management.

Thorough training in the principles of configuration management and the application of those principles in engineering support management is required.

The HQLC Engineering Introduction Course is poorly designed and does not teach the incumbent any of the knowledge required to carry out their duties. Currently, "on-the-job" training is considered adequate and this situation promotes variation and a lack of procedural standardization of the engineering functions throughout the various Directorates.

Need to determine policy and procedures in plain and simple English.

More emphasis should be put on configuration management during introductory courses to Logistics Command, and Units should be more aware of consequences of configuration management to their equipment.

Configuration management could be introduced to all RAAF personnel during their initial training periods.

A higher quality of procedural documentation needs to be developed and maintained by a working group, especially with the formation of WSLM .

The rate at which configuration changes are made must be slowed down so that all relevant publications can be amended to show the change before the next change is made. The equipment could be obsolete before the relevant publications are up to date.

Configuration management needs a higher priority over current duties.

Equipment modification status must be maintained from the start of its introduction into Service.

Configuration management is subordinated to efforts required to manage the "running system".

Need to update LBRIs to reflect correct procedures, and the source of information pertaining to those procedures. Also need to consolidate configuration management procedures into one document.

Configuration management must be an integral part of RAAF procedures, not an addendum to those procedures.

Clarification of all configuration management requirements is essential in all stages of RAAF procedures.

Appointment of Configuration Control Boards is essential.

Appointment of dedicated configuration managers would provide a distinct advantage.

Need to clarify responsibilities regarding configuration management and to better educate personnel on the "nuts and bolts" of the procedures.

Establish a RAAF sponsored course on configuration management for SYSENGs.

Educate the users of the MITE abut configuration management and its importance with regard to life cycle cost, efficiency, and operational effectiveness and safety. Provide formal training in correct configuration management procedures, within six months of posting into HQLC.

Configuration management should be stringently applied by Project Engineers when introducing new equipment and prior to hand-over to the running system manager.

General Comments

You can never get all drawings, calculations, etc, because many are propriety. This limits our control of configuration.

A move to electronic publications will eliminate the need for a middleman (SOPUBS) and allow move towards real-time updates.

Some Foreign Source Data will never be released to Australia

Not all relevant publications for my MITE are available from the manufacturer yet.

Although the need to modify equipment is becoming more critical, manpower is decreasing so that publication amendments have, and will continue, to suffer.

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Vita

Flight Lieutenant John F.Turner was born on 29 September 1957 in Darwin, Australia. In October 1975 he joined the Royal Australian Air Force (RAAF) as a Radio Technician (Air) and attended the RAAF School of Radio. On completing his studies, he served with Number 2 Flying Training School and Number 481 Maintenance Squadron were he performed maintenance duties on aircraft communication and navigation equipment. In 1981, Flight Lieutenant Turner was accepted to undergo full time training at the University of Newcastle where he completed the requirements for a Bachelor's Degree in Electrical Engineering. He was subsequently Commissioned as a RAAF Engineering Officer in December 1985 and assigned for duties as a Systems Engineer in Headquarters Logistics Command where he was responsible for engineering management of RAAF Air Traffic Control communication systems. During this time, he completed a Bachelor's Degree in Economics at Monash University. Flight Lieutenant Turner entered the School of Systems and Logistics at the United States Air Force Institute of Technology in May 1991.

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	September 1992	Master's Thesis

4. TITLE AND SUBTITLE
A STUDY OF CONFIGURATION MANAGEMENT AT HEADQUARTERS LOGISTICS COMMAND (ROYAL AUSTRALIAN AIR FORCE)

5. FUNDING NUMBERS

6. AUTHOR(S)
John F. Turner, Flight Lieutenant, RAAF

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Air Force Institute of Technology, WPAFB OH 45433-6583

8. PERFORMING ORGANIZATION REPORT NUMBER
AFIT/GLM/LSM/92S-41

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; distribution unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The purpose of this research was to provide insight into configuration management at the Royal Australian Air Force's Headquarters Logistics Command (HQLC) by determining whether current configuration management practices have any impact on HQLC's ability to meet its mission of providing logistics support. The research begins with a review of RAAF configuration management policy and procedures as applicable to in-service systems or technical equipment.

A case study is used to investigate problems associated with inadequate configuration management being experienced by one HQLC engineering section, and to identify subsequent effects on engineering logistics capability. The case study results are used to design measurement questions on a survey instrument which is used to gather data on HQLC Logistics Engineering (LOGENG) Branch as a whole.

The research indicated that configuration management has not been fully adopted by HQLC LOGENG. Additionally, HQLC LOGENG sections are experiencing the same problems and associated effects as was found in the case study.

Recommendations include: establishing training courses over the short and long terms, establishing a configuration management Centre of Excellence, and creating a HQLC project team to fully investigate the introduction of configuration management as a fundamental management tool.

14. SUBJECT TERMS	15. NUMBER OF PAGES
Configuration Management, Logistics Management, Data Management, Systems Management.	164
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

AFIT Control Number AFIT/GLM/LSM/92S-41

AFIT RESEARCH ASSESSMENT

The purpose of this questionnaire is to determine the potential for current and future applications of AFIT thesis research. Please return completed questionnaires to: AFIT/LSC, Wright-Patterson AFB OH 45433-9905.

1. Did this research contribute to a current research project?

a. Yes b. No

2. Do you believe this research topic is significant enough that it would have been researched (or contracted) by your organization or another agency if AFIT had not researched it?

a. Yes b. No

3. The benefits of AFIT research can often be expressed by the equivalent value that your agency received by virtue of AFIT performing the research. Please estimate what this research would have cost in terms of manpower and/or dollars if it had been accomplished under contract or if it had been done in-house.

Man Years _____ $ _____

4. Often it is not possible to attach equivalent dollar values to research, although the results of the research may, in fact, be important. Whether or not you were able to establish an equivalent value for this research (3, above) what is your estimate of its significance?

a. Highly Significant b. Significant c. Slightly Significant d. Of No Significance

5. Comments

_____ _____

Name and Grade Organization

_____ _____

Position or Title Address

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